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The Role of Cognitive and Acceptance Components in Predicting Functional and Emotional Adjustment to Chronic Pain

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Abstract

Introduction

The current literature highlights the significant role of psychological factors including cognitive (pain related thoughts and beliefs) and acceptance components (pain willingness, activity engagement, psychological inflexibility) in the management of chronic pain. The research is however in the preliminary stages in terms of investigating the specific relationships that exist between these psychological processes in their ability to predict adjustment to pain. This study aims to extend the current findings by investigating the relationships between several cognitive and acceptance components in their ability to predict emotional and physical adjustment in the context of chronic pain. The hypotheses that cognitive and acceptance components mediate the relationship between pain severity and pain adjustment, and also that acceptance mediates the relationship between cognitive components and pain adjustment will be tested.

Method

The study employed a cross-sectional survey-based design, including 214 chronic pain patients recruited from an NHS pain clinic. Participants completed a series of self-report questionnaires measuring pain severity, fear of movement beliefs, pain self-efficacy beliefs, pain catstrophising, acceptance and psychological flexibility, pain disability, and depression and anxiety. Structural Equation Modeling was used in order to conduct path analyses, investigating the complex relationships between these variables in predicting physical and emotional adjustment to chronic pain.

Results

The results from a Confirmatory Factor Analysis indicated that a three factor model comprising pain, cognitive and acceptance components as separate latent variables had a poor fit and therefore could

not be used in further analysis. The results of path analyses showed that pain self-efficacy was the only variable to have a strong mediating influence between pain and physical adjustment. Findings also supported a nested path model demonstrating that acceptance, catastrophising and self-efficacy were mediators between pain and emotional adjustment, and that acceptance was also a mediator for pain catastrophising and a partial mediator for pain self-efficacy in their relationship with emotional adjustment.

Conclusions

The importance of pain self-efficacy specifically in predicting physical adjustment to pain is highlighted. A more complex model however is required to explain emotional adjustment, with acceptance playing a more prominent role in comparison with other variables. The findings also provide support for both Cognitive and Acceptance-based interventions in improving adjustment to living with chronic pain. Given the preliminary nature of these findings, further research employing similar statistical methods are required to provide further support.

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Introduction

2.1 Prevalence of pain and characteristics within the population

Pain is a major health condition affecting 13% of the UK population and over 19% of people in Europe (Breivik *et al.,* 2006). Research within the US has indicated that pain is the most frequent reason for seeking help from a physician (Abbott & Fraser, 1998). Aside from the cost of health care resources utilised, chronic pain costs the American economy an estimated $61.2 billion on loss of productivity alone (Stewart *et al.,* 2003). Evidence has also highlighted that the prevalence of pain is increasing at a considerable rate (Sinnott & Wagner, 2009).

Research has also provided insight into the experience of pain, showing that pain more commonly exists in more than one body site, with 73% of individuals within a pain population experiencing multi-site pain (Carnes, 2007). Chronic pain has also been associated with comorbid psychiatric disorders. Research has shown that the diagnosis of a depressive illness is far more likely within a chronic pain population compared to the general population, with a UK study reporting that 16.9% of patients with widespread prolonged pain had a psychiatric disorder (Benjamin *et al.,* 2000). Conversely, the presence of a depressive disorder can also increase the likelihood of developing chronic pain, with a study showing that patients were 3 to 7 times more likely to develop various physical conditions if they were depressed (Hotopf *et al.,* 1998).

2.2 Impact of Chronic Pain

As these statistics suggest, the physical experience of pain is far from the only challenging aspect of chronic pain, with the psychological consequences alone creating a considerable struggle. The significant losses in terms of functional, emotional, social and socioeconomic factors can have a

profound impact upon the lives of chronic pain sufferers (Turk, 2011). As a result, psychological well-being can be significantly compromised as highlighted by psychological wellness models that emphasise the importance of six main components in preserving psychological well-being, namely; a sense of autonomy over one's life, environmental mastery, continuous personal growth, positive relations with others, a sense of purpose in life and self-acceptance (Ryff & Keyes, 1995).

The losses experienced can therefore influence beliefs regarding the self and pain, including reduced self-efficacy (Brekke *et al.,* 2003), and perceived control over their life (Rotter, 1966). Mood disorders such as anxiety and depression can also be the consequence of poor psychological well-being. This can create a cyclical relationship with the experience of pain and further contribute to increases in pain chronicity (Magni *et al.,* 1994; Vlaeyen & Linton, 2000).

2.3 Definitions of Pain

Pain has been defined by the International Association (1986) for the study of pain as:

'An unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage'.

The IASP continue by defining chronic pain as:

'Pain without apparent biological value that has persisted beyond the normal tissue healing time (usually taken to be 3 months).'

The subjectivity of pain and complexities of chronic pain do make it a very difficult concept to define. As a result, many authors have criticised the IASP definition due to its focus upon duration of the pain experience rather than intensity or resulting level of functional disability (Dunn, 2008). Pain may also be classified into two categories: nociceptive pain that is associated with activation of nociceptors in reaction to injury or inflammation, and lasts for less than 3 months, or neuropathic pain caused by damage or disease of the peripheral or central nervous system (Cox, 2010). This can be helpful in

clarifying the underlying biological and physiological processes that separate acute and chronic pain states.

2.4 Biopsychosocial Models of Pain

2.4.1 Gate Control Theory

Contrary to traditional biomedical models of pain, which focus solely on the biology and physiology of pain, the latter half of the 20th century saw a transition to a model of pain which considered the role of emotional, social, psychological and environmental factors (Kerns, 2011). Melzack and Wall (1965) introduced the Gate Control Theory of pain, which was one of the first theories to adopt a Biopsychosocial model of pain. The Gate Control theory was based on the premise that pain existed as a function of the central nervous system, whereby neural sensory inputs were transmitted to the brain to invoke the pain sensation. Thus these fibres which carry information associated with injury or damage would open a gate in order to be transmitted to the brain.

Furthermore, they suggested that the gating mechanism is also influenced by signals then descending from the brain. It was proposed that these neural signals were modulated by emotional and cognitive factors before subsequently being redirected to the area experiencing pain (Melzack & Wall, 1965). This theory therefore highlighted the combination of physiological and psychological factors within the experience of pain.

2.4.2 The Neuromatrix Model of Pain

Issues were raised, however, in relation to the suitability of the Gate control Theory, including its inability to explain phantom limb pain, resulted in the development of a 'Neuromatrix' model of Pain. Melzack (1999) proposed this new model which explained the presence of pain with the absence of injury (Melzack, 1999). The 'neuromatrix' referred to patterns of brain activation that did not require any sensory input. It was suggested that, in accordance with the Gate Control Theory, emotional, cognitive

and social factors could influence these patterns of brain activity, thus affecting the pain experience. It was highlighted that there was a relationship between the release of cortisol into the brain in response to pain which could increase susceptibility to psychological disorders, while simultaneously the presence of cortisol in association with external life stressors and psychological difficulties could also increase the severity of the pain sensation (Melzack, 2005).

2.4.3 Learning Theory

The work of Melzack prompted further theories regarding the nature of pain which adopt a Biopsychosocial model. The operant conditioning model of learning was first introduced into the area of pain to explain the role of reinforcement in adopting various pain behaviours, which can be unhelpful in the long-term management of the pain condition (Fordyce, 1976). In order to communicate the pain experience to others, pain sufferers can often engage in behaviours which facilitate pain avoidance and that also increase the focus on their pain, which can in turn be reinforced by others. Such avoidant behaviours can considerably reduce activity levels and tend to foster dependency upon others, thus leading to increase debilitation due to pain.

2.4.4 Diathesis-Stress Model

A further model, similarly depicting biological social and psychological components, is the Diathesis-Stress model (Turk, 1999). Despite similarities in subjective severity level of pain, individuals can vary in their ability to manage their pain. This model proposes that a predisposition of a reduced threshold for nociception exists for some individuals, which influences their response to this painful stimulus (Turk, 1999). Consequently, hereditary, personality and resiliency factors, social learning and prior experiences can all create a pre-disposition or diathesis to the experience of pain. The model highlights how cognitions, behavioural factors, emotional and social elements can interact with this diathesis to influence an individual's ability to manage their pain (Turk & Okifuji, 2002).

Beliefs and attributions about the nature of pain, self-efficacy beliefs, and fear of re-experiencing pain can all influence how a person responds to pain. Thus maladaptive coping strategies, catastrophic interpretations, and hypervigilance to symptoms of pain contribute to behaviours which may affect the debilitating nature of pain. A diathesis to a chronic pain condition therefore means that the individual may only develop this condition if another stressor is present (Turk *et al.,* 1995). This model can also be helpful in providing an explanation for the comorbidity of a depressive disorder in chronic pain, whereby the presence of other significant stressors associated with chronic pain symptomatology can lead to increased psychiatric distress (Banks & Kerns, 1996).

2.4.5 Fear-Avoidance Model

Similarly, the fear-avoidance model highlights the role of specific beliefs about pain and the resulting behaviours which can have adverse effects upon the pain experience (Waddell, 1993). This model is based on the central principles that avoidance of activities is not directly related to pain severity, but influenced to a greater degree by beliefs regarding the harm and injury associated with the experience of pain. An individual who responds to the pain sensation with a highly catastrophic interpretation of the nature of that sensation, will experience increased physiological arousal and cognitions and behaviours associated with a fear response (Turk & Wilson, 2010). Cognitions regarding the threat of pain subsequently increase focus on the pain sensation resulting in further catastrophic cognitions arising and avoidance of activity, ultimately decreasing mobility.

2.5 Current Psychological Treatment Models

2.5.1 Cognitive Behavioural Approaches

The literature indicating the importance of psychological factors in pain management has been well established with a number of recent reviews highlighting the utility of psychological interventions in improving pain outcomes (Eccleston *et al.,* 2009; Glombiewski *et al.,* 2010; Hoffman *et al.,* 2007). One of the thoroughly evidenced psychological approaches to pain is that of Cognitive Behavioural Therapy

(CBT). This approach is based upon the premise that the experience of pain is not solely based upon nociception, but is determined by the manner in which pain is interpreted, dependent upon appraisals, selective attention, ascribed meaning and learned responses (Turk, 1994). The cognitive aspect of CBT in the context of pain management therefore focuses on altering cognitions including unhelpful beliefs systems, distorted thinking patterns, and selective abstraction. Behavioural aspects place emphasis on changing unhelpful behaviours which maintain psychological and pain management difficulties, including avoidant behaviours and other maladaptive coping strategies (Turk, 1994).

CBT draws upon the Diathesis-Stress Model (Turk *et al.,* 2002) and Fear-avoidance Model (Waddell *et al.,* 1993) to highlight the role of unhelpful beliefs regarding the self and the nature of pain in increasing difficulties in managing pain. Challenging fears of re-injury, increasing perceived control over pain and increasing the individual's perceptions regarding their own capabilities in managing their pain (self-efficacy), has been shown to be effective in reducing pain disability and improving psychological status (Affleck *et al.,* 1987; Asghari & Nicholas, 2001; Jensen *et al.,* 1999; Jensen *et al.,* 2007; Sarda *et al.,* 2009;Turner *et al.,* 2007). Catastrophic thinking patterns can develop from an individual's maladaptive beliefs about themselves and their pain, which again have been shown to play a significant role in predicting adjustment to pain (Jensen *et al.,* 2007; Turner *et al.,* 2000). By challenging catastrophic thoughts, CBT aims to reduce the prevalence and severity of these and therefore improve psychological and pain management.

Other cognitive factors refer to selective abstraction as contributing to attention, anticipation and hypervigilance to pain. Attention to pain produces an automatic physiological response and can increase the prevalence of catastrophic interpretations (Turk, 1994). This increases the perceived threat of pain resulting in hypervigilance, whereby an unintentional additional focus is placed upon the potential pain stimulus in preparation to gain control and to escape, therefore endorsing avoidant behaviours (Crombez *et al.,* 2005). In line with social learning theory, behaviours which are considered socially appropriate in the context of pain (such as behaviours which produce sympathy and

attention, thus reinforcing pain), as well as avoidant behaviours, further increase the level of debilitation associated with pain (Turk, 1994).

In order to reduce unhelpful beliefs, thoughts and attentional biases, and to promote more helpful behaviours, CBT approaches to pain employ traditional CBT strategies and methods. These include; methods to facilitate identification of thought patterns and underlying beliefs, techniques of challenging unhelpful thoughts and accumulating contradictory evidence to negate specific thoughts and beliefs (Beck, 1976). Similarly traditional behavioural activation techniques are also employed, which do however place more emphasis on the pacing and spacing of activities and relaxation methods, in order gradually to increase pain tolerance and fitness, whilst avoiding over-exertion (Marks *et al.,* 2006).

2.5.2. Acceptance – Based Approaches

Over the past decade, adaptations to this cognitive behavioural model have included the concept of acceptance as the main principle in adjustment to pain. This has been considered to consist of pain willingness and activity engagement (McCracken *et al*., 2004), the former, which refers to the extent that pain is allowed to be experienced by the individual without attempts to avoid, and the latter to the level of activity engaged in, despite the level of pain. The concept of acceptance suggests that by being more willing to experience specific thoughts, emotions and sensory aspects associated with pain, this can reduce the level to which behaviour is controlled by the pain stimulus and encourages behaviours which correspond more with the reinforcement of values and engagement in life.

Therefore, as opposed to altering the severity and frequency of thoughts and nature of beliefs, acceptance-based approaches postulate that it is how an individual responds to these internal experiences rather than the actual content, which increases distress. The fewer attempts at controlling and escaping the pain, the less likely avoidant behaviours (which increase disability) will occur (McCracken *et al.,* 2005). Research has shown that greater levels of acceptance result in reduced experience of pain, pain related anxiety, avoidance, depression and disability (McCracken *et al.,* 2004).

Acceptance and Commitment Therapy (ACT) is a third wave cognitive behavioural approach whose development was influenced by interest regarding the specific processes that were conducive to behaviour change within CBT approaches (Hayes *et al.,* 1999). The premise that altering thoughts and beliefs is necessary for subsequent behaviour change has been challenged and emphasis has been placed on the context of a thought rather than the content (Jacobson *et al.,* 1996; Burns & Spangler, 2001). ACT holds the concept of psychological flexibility as its central tenet, which consists of six underlying processes: acceptance, contact with the present moment, cognitive defusion, a sense of self as observer, values-based action and committed action (Hayes *et al.,* 2006). ACT highlights the importance of being able to recognise, create distance from and contextualise unhelpful thoughts and beliefs (Hayes, 2004). By being present and willing to experience distressing thoughts, emotions and sensations regarding one's pain, instead of avoiding these experiences, an individual can become more accepting of these internal events and increase their psychological flexibility, allowing a more value consistent life (McCracken, 1998; McCracken, 1999; McCracken, 2005; McCracken & Eccleston, 2003).

Another acceptance-based approach is that of Mindfulness, which is regularly utilised within ACT as a strategy for enhancing acceptance and psychological flexibility (McCracken, 2005). Mindfulness within the context of chronic pain aims to develop a detachment from the experience of pain by helping the individual to recognise pain as merely sensations within the body, and to view negative attributions and catastrophic interpretations towards this sensation as a product of the mind, which do not require action (Kabat-Zinn, 1982). This practice increases acceptance of the pain experience, and, similarly, willingness to allow thoughts regarding one's pain to simply be there. Mindfulness meditation approaches exist in the forms of Mindfulness Based Stress Reduction (Kabat-Zinn, 1982; Kabat-Zinn *et al.,* 1985), which involves moment-to-moment awareness of mental processes, and Mindfulness-Based Cognitive Therapy (MBCT), which facilitates acceptance of thoughts and feelings without judgement (Segal *et al.,* 2002).

2.6 Aims of the Current Research

There has been considerable growth in research considering acceptance-based approaches including ACT and Mindfulness, within the area of chronic pain (Gardner-Nix *et al.,* 2008; Goldenberg, 1994; McCracken & Eccleston, 2005; Vowles & McCracken, 2008). However, few outcome studies have been conducted within the area of chronic pain that compare CBT and Acceptance-based approaches. The current research is therefore concerned with comparing the utility of these two approaches in improving the management of pain. Initially by reviewing the existing research considering cognitive and acceptance-based approaches to pain the current research will aim to provide insight into both treatment approaches within chronic pain, providing a comparison of the efficacy of Cognitive and Acceptance-Based approaches, whilst also considering the quality of research within each area. Secondly, in order to investigate in greater depth the theoretical concepts underlying both approaches, this research will consider the different psychological processes that are suggested to influence adjustment to chronic pain. By evaluating the specific relationships between pain, cognitive and acceptance components and adjustment to pain, this research aims to obtain further insight into to the comparative value of both Acceptance and Cognitive-based approaches for chronic pain.

3

Journal Article: Systematic Review

The Efficacy of Third Wave Interventions and Cognitive-Based Interventions in Improving Psychological and Physical Adjustment to Chronic Pain: A Systematic Review.

Prepared for Submission to 'Health Psychology Review'

The efficacy of third wave interventions and cognitive based interventions in improving psychological and physical adjustment to chronic pain: A Systematic Review

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Abstract

Modern approaches to pain management have recognised the role of psychological factors in improving adjustment to chronic pain. Considerable research has been conducted into the effectiveness of Cognitive Behavioural Therapy (CBT) for chronic pain, and the research is also growing for third wave approaches, including Mindfulness approaches and Acceptance and Commitment Therapy (ACT). This review aims to assess the evidence base for both approaches, by evaluating the Randomised Controlled Trials (RCTs) conducted and by making direct comparisons based from effect sizes produced for each outcome of pain, physical functioning and psychological status. A systematic review of the literature was performed up until and including March, 2012. A detailed assessment of the quality of studies was also conducted using a Quality Rating Scale, designed specifically for psychological intervention studies within a chronic pain population. The results show equivalent mixed findings for the efficacy of both cognitive and third wave approaches in their ability to improve physical and psychological adjustment. From the studies selected a clear need for more RCTs employing an ACT approach is observed. Consideration of the quality constraints

[1] Although the other two authors are credited on this paper due to the supervision they have provided, the writing is the work of the first author/principal researcher.

identified, highlights the necessity for further research of a higher quality in order to establish the potential superiority of one approach over the other or equivalence and to identify the role of the specific process variables contributing to treatment outcomes.

Background

Pain is a common condition currently affecting around 7.8 million people in the UK and over 19% of the population in Europe (Breivik, Collett, Ventafridda, Cohen & Gallacher, 2006; Chief Medical Officer, 2008). Studies in the US have estimated the cost of chronic pain to the American economy, on loss of productivity as $61.2 billion dollars (Stewart, Ricci, Chee, Morgansstein & Lipton, 2003). Chronic pain has been defined as pain that persists beyond the expected time for the healing of tissue, which is considered to be a minimum of 3 months in duration (Smith, Hopton & Chambers, 1999). For many, this is a severely debilitating condition, characterised not only by considerable difficulties in physical functioning but also significant psychological distress (Jelicic & Kempen, 1999).

Of particular relevance in aiding understanding of this complex condition, is the Biopsychosocial model, which posits that health and functioning are influenced by psychological, social and physical components (Engel, 1977). Studies have highlighted the interdependent relationship between pain, psychological distress and physical functioning, whereby although pain can contribute to psychological difficulties (Cohen *et al.,* 1995), it is suggested that increased psychological distress can also intensify the pain experience (Truchon, 2001). Further, although pain and psychological difficulties are predictive of the level of physical functioning, equally reduced physical functioning can also have a marked impact upon pain and psychological distress (Wegener, Castillo, Haythornwaite, MacKenzie & Bosse, 2011).

Role of Psychological Components in Adjustment to Pain

Cognitive Behavioural models considering pain have highlighted the importance of cognitive factors such as beliefs and thoughts about pain in predicting physical and psychological adjustment to pain (Jensen, Turner, Romano & Karoly, 1991). A number of studies have highlighted the influence of pain locus of control and more recently the emphasis has shifted to the concept of pain self-efficacy in managing pain. These studies have shown that lower levels of self-efficacy and perceived pain control can result in reduced activity and ultimately poorer pain prognosis (Perry, Nicholas & Middleton, 2009; Sarda, Nicholas, Asghari & Pimenta, 2009; Turner, Holtzman & Mancl, 2007). Self-efficacy beliefs refer to the perceived level of ability and confidence the individual has in being able to execute a particular activity despite their pain, whereas the latter, pain locus of control, represents the extent to which an individual feels they can control their pain experience (Asghari & Nicholas, 2001; Main & Waddell, 1991; Turk & Okifuji, 2002).

Other pain appraisals and beliefs include fear of pain and fear of movement due to the experience of pain. These have also been suggested to play a role in physical and psychological functioning (Asmundson, Bovell, Carleton & McWilliams, 2008; Crombez, Vlaeyen, Heuts & Lysens, 1999). Finally cognitive coping strategies such as catastrophising have also been suggested to influence adjustment to pain (Hirsh,George, Bialosky & Robinson, 2008; Turk, 1994). Fear-avoidance models highlight the role of increased fear appraisals and catastrophising in increasing avoidance of activity and thus exacerbating the debilitating effects of pain.

More recently, models of pain have incorporated the concept of acceptance and psychological flexibility in predicting physical and emotional functioning in response to pain (McCracken & Vowles, 2007). Psychological flexibility within the context of pain places emphasis on how an individual responds to their experience of pain and to unhelpful thoughts and beliefs related to their pain, highlighting the

importance of the context in which these internal experiences occur, rather than the specific content of these.

That is, by consistently attempting to avoid pain and escape unhelpful cognitions regarding pain, irrespective of their content, this can increase psychological inflexibility, which exacerbates the individual's levels of distress. By being more accepting of pain sensations, thoughts and emotions, and therefore being able to perceive specific pain cognitions in context, an individual can be less inclined to engage in avoidant behaviours and which can decrease the debilitating effect of chronic pain (McCracken,Vowles & Eccleston, 2004; Vowles & McCracken, 2010). Therefore the premise that altering thoughts and beliefs is necessary for subsequent behaviour change has been challenged and alternatively, emphasis has been placed on how an individual responds to these.

A number of studies have highlighted the importance of acceptance and psychological flexibility in predicting adjustment to chronic pain (McCracken et al., 2005; McCracken & Eccleston, 2006; Vowles *et al.,* 2007; Vowles *et al.,* 2011; Vowles & McCracken, 2010; Wicksell, Lekander *et al.,* 2010). Both acceptance and cognitive variables have been found to have a mediating and/or moderating role between pain and emotional and/or functional adjustment to pain (Arnstein *et al*; 1999; Arnstein *et al*., 2000; Barakat *et al.,* 2007; Elander *et al.,* 2009; Gillanders *et al.,* Submitted; Kratz *et al.,* 2007; Miro *et al.,* 2011). The potential mediating role of acceptance variables in the relationship between cognitive components and adjustment to pain has also been suggested in studies demonstrating acceptance as a mediator between variables including catastrophising and negative thoughts, and physical and psychological functioning (Elander *et al.,* 2009; Vowles *et al.,* 2008). Such findings are correspondent with theory underlying acceptance-based approaches, which emphasises the importance of context rather than content.

Psychological Approaches

Pain management interventions to date have predominantly adopted a Cognitive Behavioural Therapy (CBT) approach. Based on the existing evidence which demonstrates the influence of beliefs and cognitions in adjustment to pain, CBT aims to change dysfunctional beliefs, thoughts and behaviours regarding the individual's pain. This has been shown to be an effective approach in improving physical and emotional functioning in the context of chronic pain (Morley, Eccleston & Williams, 1999; Eccleston, Williams & Morley, 2009). In more recent years there has been increasing research conducted into the role of acceptance-based approaches or third wave interventions, in improving pain management. Acceptance and Commitment Therapy (ACT) (Hayes, Strosahl & Wilson,1999; Hayes, Strosahl & Wilson, 2011) and Mindfulness (Kabat-Zinn, 1982) are two such interventions that focus on improving psychological flexibility and increasing acceptance towards pain, and have been shown to be effective in two recent meta-analyses (Bohlmejer, Prenger, Taal & Cuijpers, 2010; Veehof, Oskam, Schreurs & Bohlmeijer, 2011).

Aims of this Systematic Review

A number of recently conducted systematic reviews and meta-analyses have provided evaluations of the available psychological interventions for chronic pain in general (Chiesa & Serretti, 2011; Eccleston, Williams *et al.,* 2009; Veehof *et al,* 2011), and for disease specific conditions including Fibromyalgia and Rheumatoid Arthritis (Astin, Beckner, Soeken, Hochberg & Berman, 2002; Glombiewski, Sawyer, Gutermann, Koenig, Rief & Hofmann., 2010). These studies have highlighted the effectiveness of CBT approaches in improving pain adjustment and have also provided promising results for third wave interventions within this population. However to date there has not been a systematic review which comparatively evaluates both CBT and third wave approaches directly within this population, in terms of the quality of studies conducted and their effects upon pain adjustment.

This systematic review therefore aims to evaluate the effectiveness of CBT and third wave interventions in improving physical and emotional adjustment to chronic pain by including studies which employ CBT, ACT and mindfulness-based approaches. In doing so, comparisons will be able to be made regarding the quality of studies in each of these areas and the strength of outcomes produced in improving functioning within a general chronic pain population. In order to expand upon previously conducted systematic reviews, this review aims to employ stricter inclusion criteria to ensure only studies of the highest quality are identified for review.

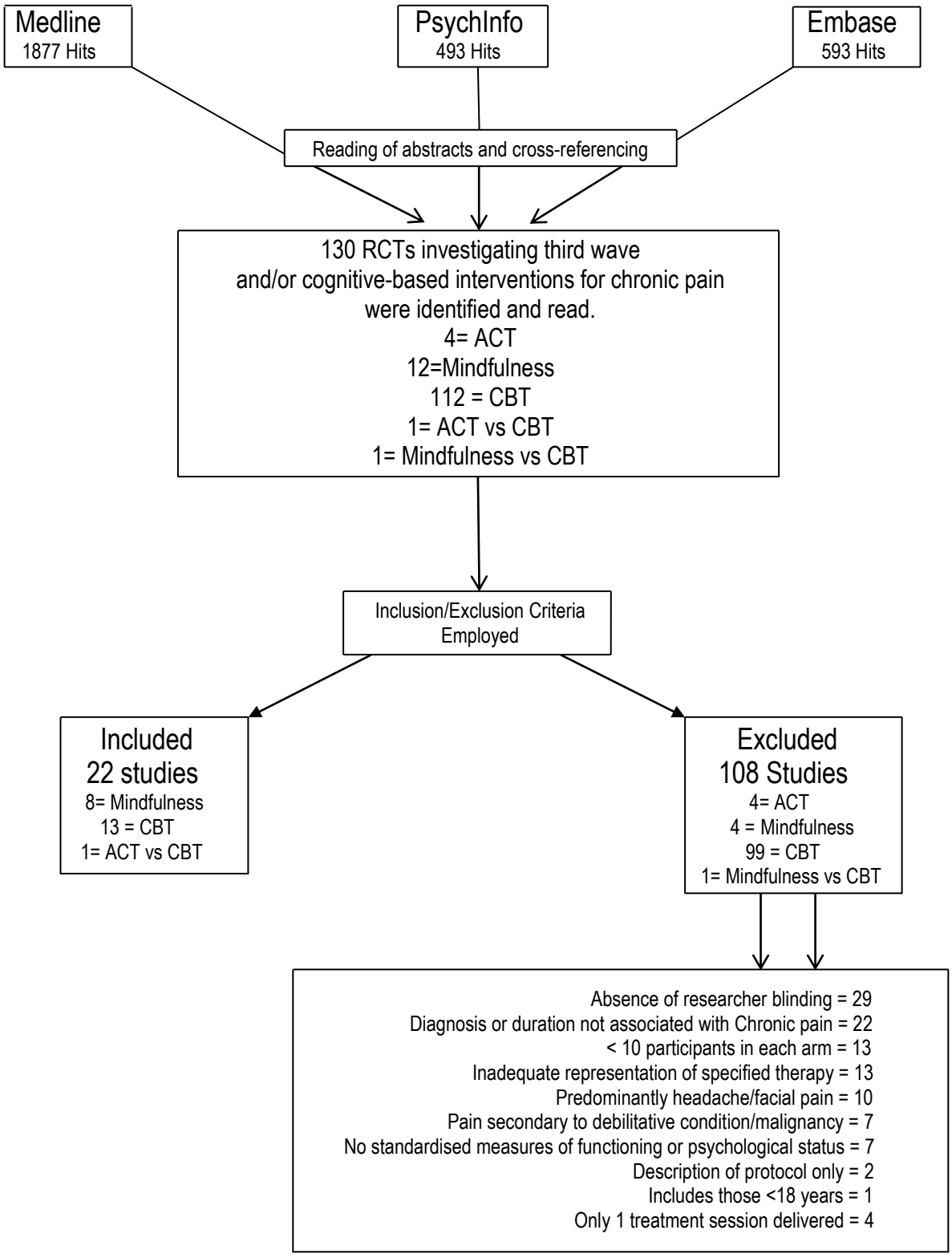
Databases and Data Treatment

Search Strategy

A systematic search of randomised controlled trials (RCT's) investigating acceptance-based and/or cognitive based interventions for a chronic pain population was conducted, up until and including March, 2012. Three databases, Medline, PsychInfo and Embase were systematically searched to identify relevant studies. These databases were the most frequently searched in the previously mentioned systematic reviews assessing psychological interventions for chronic pain. They were selected for this review based on their wide usage for identifying literature within this specific area.

In order to develop a comprehensive list of search terms, the researchers generated a list of all of the possible terms which were relevant to the current systematic review, as well as considering those employed in previous relevant systematic reviews. The search terms employed were 'pain' and ('acceptance', or 'ACT', or 'behaviour*', or 'beliefs', or 'CBT', or 'Cog*', or 'commitment', or 'flexibility', or 'fusion', or 'MBCT', or 'MBSR', or 'meditation', or 'mindfulness', or 'psych*', or 'self-efficacy', or 'therapy', or 'values', or 'willingness'). Limits on this search included availability within the English Language, Human studies, adult population (18 and above), and Randomised Controlled Trials only. This search elicited 1877 hits within Medline, 493 within PsychInfo and 593 for Embase.

Figure 1: Flow Diagram Illustrating Procedure for Selecting Studies



The titles and abstracts of these were then read in order to identify relevant RCT's that investigated the efficacy of third wave and/or cognitive-based interventions for chronic pain. The RCT's that were selected were cross-referenced in order to identify other suitable studies for the review. Previous systematic reviews and meta-analyses similarly assessing psychological interventions in the treatment of chronic pain conditions were also cross-referenced to ensure relevant RCT's had not been overlooked. This process resulted in 129 relevant RCT's being selected and read to be assessed for inclusion within this review. Figure 1 is a flow-diagram illustrating the selection procedure undertaken (see figure 1).

Inclusion

This review was interested in examining RCT's whereby Cognitive Behavioural Therapy and/or third wave approaches were being investigated within a pain population. Studies involving a comparison between these interventions, or with an active control group, treatment as usual group or waiting list group were included. It was necessary that treatment be delivered over more than one session, be conducted face to face by a therapist either on an individual basis or group setting, for inclusion. Participants were required to have either had a formal diagnosis from a physician of a chronic pain associated condition, and/or were attending a pain clinic with minimum pain duration of 3 months. Adults 18 and above whose pain was their primary cause of physical difficulty and where pain was not secondary to another disease process or malignancy were also included.

In terms of methodological considerations, studies were only included if they used standardised measures to obtain outcomes from treatment in the form of psychological and/or functional adjustment to pain. It was necessary that blinding to treatment condition was attempted in order to reduce

researcher bias, and finally, studies were required to have at least ten participants in each treatment arm during the analysis stage.

Exclusion

In order to establish appropriate exclusion criteria the researcher considered that employed in previous systematic reviews assessing psychological interventions within the area of chronic pain, whilst also developing specific criteria, where necessary, based on the specific aims and purpose of the current systematic review. Studies where participants did not meet the criteria for a chronic pain condition (e.g. formal diagnosis or minimum duration of 3 months specified) were excluded. Studies whereby participant's pain was associated with a malignant disease process (e.g. cancer) and/or was not the primary reason for disability (e.g. spinal cord injury) were excluded. Furthermore, in accordance with previous systematic reviews (Eccleston, Williams *et al.,* 2009; Morley *et al.,* 1999), studies were excluded if they comprised of predominantly headache. This was due to treatment provision and outcomes being deemed sufficiently different in comparison with other chronic pain conditions (Morley *et al.,* 1999).

In addition, as the current review is interested in physical functioning as an outcome of treatment, studies which included a facial pain only sample were excluded, as it was considered that this could potentially be associated with a lesser degree of activity interference in comparison to other pain conditions. Studies that did not appear to accurately represent the named interventions in terms of content (e.g. a CBT intervention which only employed behavioural strategies), duration (only one single session) or were not delivered by a therapist on a face to face basis were also excluded.

Furthermore, in line with a recent systematic review also evaluating RCT's only, studies were excluded when fewer than ten participants were present for analysis in each arm (Eccleston, Palermo, Williams,

Lewandowski & Morley, 2009). Studies where no standardised measure of psychological and physical adjustment to pain was present, were also excluded. Finally studies were assessed for researcher bias and excluded where there was no evidence of researcher blinding to treatment condition (i.e. there was no independent researcher responsible for data collection and analysis). As this was often unclear from reading the study, in this instance lead authors were emailed where possible and articles excluded if they reported no attempts to control for researcher bias or if no response was obtained.

Data Extraction

Information providing characteristics of participants, intervention type, nature of control group and attrition rates were extracted from each study. In terms of outcome measures, for the purpose of this review, data providing information on functional and/or psychological adjustment to chronic pain were extracted. This includes outcome data from measures of physical functioning and coping with everyday tasks, and from measures of psychological wellbeing and mood rating scales. Outcome data regarding pain intensity or severity was also extracted as well as other psychological components which may be influenced by the intervention, including self-efficacy, pain control, catastrophising, fear of pain, acceptance and other psychological coping strategies.

Data regarding the significance of changes in variables across time within groups and comparisons between groups across time were extracted. Effect size data, highlighting the strength of these comparisons were extracted and where necessary converted into Cohen's d to obtain consistency for comparison. Where effect sizes were not reported, Cohen's d was calculated via obtaining means and standard deviations or standard errors, and/or t values and degrees of freedom (Dunst *et al.,* 2004). Calculating Cohen's d effect sizes allows a classification of the strength of the difference between two groups to be made, whether small (d = .20), medium (d= .50) or large (d=.80) (Cohen, 1988), which

provides valuable information, in addition to significance level, regarding the magnitude of the strength of the comparative difference between two variables.

Quality Assessment

The quality rating scale employed within this review was based on that devised by Yates, Morley, Eccleston and Williams (2005), which has been developed specifically to be applied to psychological intervention studies within pain. This provides an overall quality rating out of 35 and comprises two subscales: a treatment quality scale (rating out of 9) and a methodology and design scale (rating out of 26). The treatment quality scale assesses for inclusion of the following aspects: a clear description of treatment and rationale for treatment has been provided; treatment duration has been reported; the use of a manual and evidence of adherence to this; appropriate therapist experience and training specifically for the trial, and whether patient engagement within the intervention has been assessed.

The methodology and design subscale assesses for the following: clarity of exclusion/inclusion criteria and evidence of adherence to these; reporting of attrition rates, with evidence of adherence to CONSORT guidelines and assessment to ensure differential rates of attrition are not significant; a clear description of the sample is provided and equivalency between groups has been considered; appropriate methods for randomisation have been undertaken with attempts to minimise bias by using an independent researcher, similarly researcher bias has been accounted for and participant's treatment expectations have also been considered; outcome measures are appropriate and have acceptable psychometric properties within this population; follow up at 6 months minimum; power calculations have been conducted a priori and met in terms of sample size; appropriate statistical analyses and reporting of results is apparent and an intention to treat analysis has been conducted; and finally an active well-matched active control group has been used (Yates *et al.,* 2005).

As researcher bias has already been accounted for as a criterion for inclusion/exclusion within this review, this item was eliminated from the quality ratings within this study, resulting in a design and methods rating out of 25 and an overall quality rating out of 34. All studies that were included in this review were rated by the primary researcher, utilising this scale, and a proportion of these studies were also rated by two independent researchers (6 studies each) in order to assess for inter-rater reliability.

Results

Included Studies

Employing the selection procedure, 22 RCT studies met the requirements for inclusion within this review (see Table 1). These consisted of 13 studies investigating the efficacy of CBT (Barlow, Turner & Wright, 2000; Carson *et al.,* 2006; Falcao *et al.,* 2008; Glombiewski, Hartwich-Tersek. & Rief, 2010; Greco, Rudy & Manzi, 2004; Klimes, Mayou, Pearce, Coles & Fagg, 1990; Kole-Snijders *et al.,* 1999; Lorig, Ritter & Plant, 2005; Sharpe *et al.,* 2001; Smeets, Vlaeyen, Hidding *et al.,* 2006; Thorn *et al.,* 2011; Vlaeyen *et al.,* 1996; Williams *et al.,* 1996), 8 studies assessing mindfulness-based approaches (Astin, Berman, Bausell, Lee & Hochberg, 2003; Carson *et al.,* 2010; Morone, Greco & Weiner., 2008; Morone, Rollman, Moore, Qin & Weiner., 2009; Pradhan *et al.,* 2007; Schmidt *et al.,* 2011; Sephton *et al.,* 2007; Wong *et al*., 2011) and one study comparing CBT and ACT (Wetherell *et al.,* 2011) for patients with chronic pain. No other RCT's employing an ACT approach met the requirements for inclusion.

Six studies were conducted within a sample of patients with a diagnosis of Fibromyalgia (Astin *et al.,* 2003; Carson *et al.,* 2010; Falcao *et al.,* 2008; Schmidt *et al.,* 2001; Sephton *et al,* 2007; Vlaeyen *et al.,* 1996), five within a sample of chronic back pain sufferers (Glombiewski *et al.,* 2010; Kole-Snijders *et al.,* 1999; Morone *et al.,* 2008; Morone *et al.,* 2009; Smeets, Vlaeyen, Hidding *et al.,* 2006), five within a sample of arthritis sufferers including general arthritic conditions (Barlow *et al.,* 2000; Lorig *et al.,* 2005),

Table 1: Studies Included for Review

Author	Participants	Intervention	Control Group	N	Outcome measures	Results	Effect Sizes
Astin (2003)	Fibromyalgia	Qigong Mindfulness Group(10-20) 8 x 2.5hr sessions	Education Support Group 8 x 2.5hr sessions	128 I=64 C=64	FIQ BDI MOS (SF-36 Pain)	- Significant improvements in both groups across time for FIQ, BDI and MOS SF-36 Pain scores at 8, 14 and 24 weeks. - No significant differences in group x time interaction.	- Medium effect sizes (0.50 to 0.68) for intervention group on pain, physical functioning and depression at 3 time points, except depression at post tx (0.39). - Medium effects (0.33 to 0.68) on all variables across all time points for the control.
Barlow (2000)	Arthritis	CBT-based Arthritis Self-Management Programme Group(10-30) 6 x 2hr sessions	Waiting List Control	544 I=311 C=233	ASES HAQ HADS PANAS	- Significant improvements for the intervention group on all variables except negative affect. - Intervention group found significant improvements in comparison of change scores than controls on all variables except pain and neg affect.	- Within groups analyses found small effects for CBT across time on pain, depression, self-efficacy & positive affect (0.23 to 0.39). - Anxiety & Neg affect found no within group effects. - For difference in change scores between groups effect sizes were small on all variables (0.21 to 0.43). - No effects for pain & neg affect.
Carson (2006)	Rheumatoid Arthritis	CBT and CBT plus Maintenance Training(MT). Group (4-7) 10 x 1.5hr sessions.	Education Control Group (EC) and Standard Care Group (SC). EC = 10x 1.5 hr sessions.	95 CBT=19 CBT+MT = 18 EC = 27 SC= 31	POMS (abbrev) CSQ RADAR SNDCI (abbrev)	- CBT and CBT + MT showed significant improvements at post-tx compared to the EC, & SC groups in joint pain, pain days, coping efficacy & neg affect. - Same at follow-up, with the exception of neg affect & a significant improvement in positive affect for CBT. - Also no significant differences found for self-efficacy between the CBT group & EC at follow-up & a significantly lesser increase was found for CBT+MT compared to EC.	- Comparisons between CBT & controls across time yielded large effect sizes in all variables, from 0.87 to 2.27, excluding positive mood where a medium effect was observed (0.59). - For the CBT+MT group large effect sizes were found compared to controls on coping efficacy, pain & neg affect (1.10 to 2.08) - this was a medium effect for negative mood (0.73) compared to SC. - At follow-up a medium effect was found for coping efficacy (0.77) compared to SC, & a large effect (0.89) compared to EC, & a medium effect was found for neg affect (0.64) in compared to EC.

Carson (2010)	Fibromyalgia	Mindfulness Yoga Intervention Group (7-12) 8 x 2hr sessions	Waiting List Control Group	53 I = 22 C = 28	FIQ – R CPAQ CSQ VMPCI	- Significant improvements for mindfulness compared to controls over time in FIQ-R total, and functioning, overall impact, pain, depression and anxiety subscales of the FIQ-R, as well as scores on the CPAQ Activity Engagement subscale and on the CSQ.	- Large effect sizes for mindfulness compared to controls on depression & acceptance activity engagement (0.81 and 0.87). -Medium effect size on overall acceptance (0.63), functioning (0.72) and anxiety (0.61) & small for pain severity (0.47) and the pain willingness subscale (0.09).
Falcao (2008)	Fibromyalgia	CBT Group (5) 10 sessions	Standard Care Group	60 I = 30 C = 30	FIQ MOS SF-36 BDI STAI	- Significant improvements for CBT at post treatment & at 3 months on all outcome measures excluding anxiety. - - CBT demonstrated significantly lower depression & higher scores on the mental health subscale of the SF-36 compared to controls across time.	Effect sizes were large for all variables within the CBT group from pre to post & to follow-up (0.93 to 1.67). - Exception of anxiety (0.26) at post treatment & (0.57) at follow-up. - Large effects also found in all variables for the Control group across time (0.86 to 2.04). - Again exception of anxiety (0.53 and 0.60) at post and follow-up.
Glombiewski (2010)	Back Pain	CBT & CBT+BF (Biofeedback) Individual sessions. 25 x 1hr	Waiting List Control.	116 CBT-BF = 35 CBT = 30 C = 51	GPQ DSF PDI HRLS BDI	- Both CBT interventions demonstrated significant improvements in compared to controls on pain, functioning, depression & coping strategies post treatment.	- Small effect sizes for functioning & depression (0.25 and 0.24), & medium effects of pain (0.66), with large effects resulting for coping strategies (0.80) for comparisons between CBT and Controls.
Greco (2004)	Systemic Lupus Erythematosus	CBT with Biofeedback Individual 6 sessions	Symptom Monitoring Support (SMS) group & Standard Care group (SC). SMS = 6 sessions	92 I = 32 SMS = 33 SC = 27	AIMS-2 MPI-I CES-D STRESS SF-36 ASES	- Significant improvements at post treatment in pain & psychological components (CES-D, STRESS, ASES) for CBT compared to SMS & SC groups & in physical functioning compared to the SC. - Significant improvements in psychological functioning for CBT compared to SC but not SMS at 9 months. - Significance not maintained for pain & physical functioning at 9 months.	- Medium to large effect sizes (0.50 to 1.05) on pain, depression & self-efficacy, & small effects for perceived stress & physical functioning (0.49 and 0.42) for CBT from pre to post tx. - At follow-up medium effect sizes were found for CBT on pain & self-efficacy (0.59 to 0.68), & small effect sizes on all other variables. - SC & SMS yielded only small effect sizes on all variables at post tx & follow-up (0.03 to 0.47).
Klimes (1990)	Non-Cardiac Chest Pain	CBT Individual	Waiting List Control	35 I = 18	BDI STAI	- CBT showed significantly improved scores in BDI & SRT scores in compared	Not computable.

		4-11 sessions		C = 17	SRT	to controls at post tx.	
Kole-Snijders (1999)	Chronic Low Back Pain	CBT Group(10-15) 12 x 90min sessions	Behavioural Therapy (BT) and Waiting List Control (WLC) BT= 12x90 min sessions	148 I = 59 BT = 58 WLC = 31	CHIP PCL CSQ MPCL MPQ NHQ BDI FSS-III MMPI	-Both active interventions showed significant improvements across time on neg affect, activity tolerance & pain coping compared to controls. - Significantly improved pain coping control was found for the CBT group compared to BT. - No significant interaction effects of treatment x time for CBT & BT.	- Large effect size (2.8) in overall improvement rates for active treatment groups vs waiting list control. - Medium effects (0.6) on motoric behaviour in favour of percentage of improvement for BT vs CBT . - Minimal effects for tx group x time interaction on negative affect & coping control. Unable to compute effect sizes for interactions with other variables.
Lorig (2005)	Arthritis	CBT-based Arthritis Self-Management Programme (ASMP) vs CBT-Based Chronic Disease Self-management Programme (CDSMP) Group(10-15) 6x 2hr session	None	355 ASMP = 239 CDSMP = 116	HD S-RGH AL HAI SEMCD	- Significant improvements for ASMP at 4 months on health distress, activity limitation, fatigue, pain, exercising & self-efficacy. - Significant improvement for CDSMP in activity limitation & exercise, & significant negative change in global health. - Between groups comparisons showed significantly greater improvement in ASMP for global health & fatigue.	- Small effects on pain & self-efficacy at 4 months & 12 months for the ASMP group (0.25 to 0.33), with no effect for functioning at either time. - Minimal effects were found at 4 months for CDSMP & at 1 year follow-up only self-efficacy showed a small effect (0.23).
Morone (2008)	Chronic Low Back Pain	Mindfulness Group 8 x 90 min sessions	Waiting List Control	37 I = 19 C = 18	MPQ-SF SF-36 CPAQ RMDQ SPPB	- Significant improvement for mindfulness compared to controls across time on CPAQ, Activities Engagement subscale, physical functioning in the SF-36, though not on the RDMQ. - Quality of life was also improved for mindfulness though was not significant.	- Small effect sizes were found on both measures of physical functioning & on the MPQ –SF measure of pain (0.32 to 0.46) for mindfulness compared to controls across time. - Large effect sizes were found on overall acceptance & the Activity engagement subscale, for mindfulness compared to controls across time (0.83 and 0.95).
Morone (2009)	Chronic Low Back Pain	Mindfulness	Educational Control	40 I = 20	RMDQ MPQ-SF	- No significant findings were identified between groups across time.	- Only effect sizes for mindfulness measures were computable.

		Group 8x90min sessions	Group 8x90min sessions	C = 20	CPSES SF-36 MAAS FFMQ	- Trends were observed in favour of the mindfulness group on mindfulness measures, RDMQ & SF-36.	- Minimal effects were found for all variables for the Mindfulness group across time, with the exception of a small negative effect on the non-judgemental subscale of the MAAS. - A small effect (0.35) was found for controls on the awareness subscale of the MAAS.
Pradhan (2007)	Rheumatoid arthritis	Mindfulness Group(13-18) 8x2.5hr sessions	Waiting List Control	63 I = 31 C = 32	SCL-90-R DAS PWBS MAAS	- No significant findings found between groups across time. - A significant reduction in psychological distress was found at follow-up for MBSR compared to controls. - Significant improvements were also found for wellbeing in MBSR compared to controls at follow-up.	- Small effect found for MBSR compared to the control for psychological distress and wellbeing at post treatment (0.27 and 0.38). - A small effect for mindfulness & depression (0.44 & 0.45), & a medium effect for psychological distress & wellbeing (0.50 & 0.53) was found for MBSR compared to controls.
Schmidt (2011)	Fibromyalgia	Mindfulness Based Stress Reduction Group (12) 8x2.5hrs and 1x 7hr day	Relaxation Group (R) Waiting List Control 8x2.5 hr sessions	177 I = 59 R = 59 C = 59	HRQoL (PLC) FIQ CES-D STAI PSQI PPS FMI GCQ	- Significant changes for MBSR across time on all measures. - Only PSQI, PPS Affect & GCQ were significant at follow-up for the active control. - Significant group x time differences between the waiting list & both active treatments on the STAI, & between MBSR & relaxation groups on FMI.	- Unable to calculate effect sizes from group x time helmert contrasts. - Small to medium effect sizes (0.21 to 0.50) for MBSR across time on all variables excluding the PPS sensory measure that showed minimal effect. - Small effects (0.21 to 0.30) on the PSQI, the GCQ, & the PPS affective for the active control group, & on the PPS sensory & affective measure & the GCQ for the Waiting list group.
Sephton (2007)	Fibromyalgia	Mindfulness Group 8x 2.5 hr sessions	Waiting List Control	91 I = 51 C = 40	FIQ SSQ BDI	- Significant improvements for Mindfulness on overall depression & on the BDI subscales from pre-treatment to post & to 2 month follow-up.	- Medium to large effect sizes (0.52 to 0.81) on overall depression, the cognitive/ affective & the somatic subscales for MBSR compared to controls. -Medium effect sizes for the slope of change at 2 month follow-up on total depression score & subscales scores, in favour of the intervention group.
Sharpe (2001)	Rheumatoid Arthritis	CBT	Standard Care	45 I=23	HADS CSQ	- Significant changes on depression & on reinterpreting pain at post	-Medium effects on anxiety, reinterpreting pain, & diverting attention (0.59 to 0.79), & a

		Individual 8x 1hr session		C= 22	HAQ	treatment & follow-up, & on diverting attention at follow-up for CBT compared to the control. - Other trends were in favour of CBT though not significant.	large effect for depression (0.81) between groups at post treatment. - Medium effects were identified for all (0.52 to 0.79) at follow-up.
Smeets (2006a) (2006b)	Chronic Low Back Pain	CBT & CBT + Active Physical Treatment(CT) Group (4) & individual CBT = 30 & CT = 19 sessions	Active Physical Therapy Group (APT) & Waiting List Control (WL) APT = 30 sessions	227 CBT = 60 CT=62 APT=54 WL=51	RMDQ VAS (complaints) MPQ (VAS) BDI	- Significant reductions on all active conditions compared to WL on RDQ, Main complaints & Pain, & on the BDI for APT only. - Catastrophising mediated the improvements in RDQ, complaints & Pain for all active treatments compared with WL & in BDI for APT only.	- Small to medium effect sizes on pain, functioning, depression & catastrophising (0.25 to 0.62) for CBT compared to WL over time. - Small effect sizes for CT on pain, functioning & catastrophising (0.34 to 0.47). - Small to medium effects for APT on pain, functioning, depression, catastrophising & control (0.32 to 0.70).
Thorn (2011)	Chronic Pain (low SES Population)	CBT Group (3 to 4) 10 x 1.5 hr sessions	Education Group (3 to 4) 10 x 1.5 hr sessions	83 CBT = 49 EDU - 34	BPI RMDQ PCS CES-D QOLS	- For the ITT analysis, no significant interaction effects were found for BPI, RMDQ, QOLS and PCS. - Significant effects of time for both groups on all of the above except RMDQ. - CES-D interaction did not reach significance, but effect of time was for CBT and not for EDU. - Completer sample – Significant interaction effect for CES-D and PCS. - also depression and catastrophising decreased significantly over time in CBT but not EDU. - no significant between groups at post treatment for CES-D & PCS	- unable to compute effect sizes for ITT interaction effects - effect sizes for BPI intensity, BPI interference, and PCS were small to medium (0.27 to 0.61) for CBT and were minimal to large (0.08 to 0.8) for EDU. Small effects for CBT on RMDQ (0.24), whereas minimal effect sizes for EDU (0.19). - Interaction effects for CES-D were small (0.42). Small effect sizes from pre-to post and pre to follow-up on CES-D for CBT (0.30 & 0.34) and minimal for EDU (0.07 & 0.05). - Medium effect sizes for interaction effect CES-D and PCS in favour of CBT (0.53 & 0.52). - within group effect sizes for PCS were medium for CBT (0.59 & 0.61) and minimal for EDU (0.12 & 0.08). - post treatment between groups effects sizes were minimal for CES-D & PCS (0.04 & 0.05).
Vlaeyen (1996)	Fibromyalgia	CBT + education group	Education + Discussion group	125 I=46 ED=39	DHQ FSS-III-R BDI	- Significant improvement on pain coping for CBT & ED groups compared to WL.	- Small to medium effect sizes for pain & pain control (0.43 & 0.64) for CBT from pre to post.

		Group (6) Education = 12x2hr CBT= 12x1.5hr	Waiting List Control Group ED = 12x2hr sessions	WL=40	MOCI SCL-90 PCL CSQ BAT PBS CHIP MPLC MPQ	- Significant difference in pain control for ED & WL. - Significant difference for ED compared to CBT on fear - no between group differences for WL. - No significant differences between CBT & ED at follow-up.	- Small to medium effects for pain, fear, & catastrophising (0.28 to 0.57) & a large effect was found for pain control at post time (1.15) for ED. - Small effects (0.24 & 0.32) on pain & depression for controls at post. - Effect sizes remained small to medium at follow-up for CBT (0.42 & 0.53) & ED (0.24 to 0.71).
Weatherell (2011)	Chronic Pain	ACT vs CBT Groups (4-6) Both groups= 8x1.5hr sessions	None	114 ACT = 57 CBT = 57	BPI MOS-SF MPI BDI PASS CPAQ SOPA	- Significant changes for both groups on pain interference, depression & pain anxiety. - There were no significant effects of group x time. - No mediation was observed through either group.	- Small effects for ACT on anxiety functioning, depression & acceptance (0.20 to 0.48). - Small effects for CBT on all variables (0.33 to 0.37) except functioning. - Only weak effect sizes (0.05 to 0.13) found for ACT vs CBT across all variables (0.05 to 0.13).
Williams (1996)	Chronic Pain	Inpatient CBT (IPCBT) and Outpatient CBT (OPCBT). Group (10) IPCBT = 4.5 days per week over 4 weeks OPCbT = 8x3.5hrs	Waiting List Control	121 IPCBT=43 OPCBT=45 WL=33	BDI MPI PSEQ SIP STAI CSQ PCQ	- Inpatients & outpatients had significantly improved scores compared to WL on pain impact, depression, pain self-efficacy, catastrophising, hopelessness & physical performance. - Inpatients made significantly greater gains than outpatients on all physical measures, on pain impact, depression, pain self-efficacy, catastrophising, hopelessness & anxiety. - Similar significant findings for both groups from pre to follow-up except pain intensity, pain distress & arm endurance. - Inpatients showed significantly greater improvements than outpatients on catastrophising, pain distress, depression distance walked & stairs climbed.	- Large effects were found for CBT inpatients from pre to post on functioning, catastrophising, self-efficacy & depression (1.01 to 1.15) & medium effects on pain & anxiety (0.54 & 0.68). - Small effects for CBT Outpatients on anxiety & pain (0.36 & 0.30) & medium to large on the other variables (0.76 to 0.90). - No effects were observed for controls on any of the variables. - Large effects were found for both CBT groups at 1 year for functioning, depression, catastrophising & self-efficacy (1.00 to 1.33). - A large effect was found on catastrophising (0.88), & small to medium effects (0.41 to 0.53) on all other variables for between group comparisons in favour of the inpatient group.
Wong (2011)	Chronic Pain	Mindfulness Based Stress	Multi-disciplinary	99	POMS CES-D	- Within groups - showed significant reductions in pain severity in both	Small to medium effect sizes were found for pain in both the MBSR and MPI groups across

		Reduction (MBSR) 8x2.5 hour + 1 7hr day session	pain intervention (education) 8x 2.5 hour sessions	MBSR = 51 MPI = 48	STAI SF-12 Pain NRS (intensity & distress)	groups over time. - The physical subscale of SF-12 showed significant improvements in both groups at 3 and 6 month follow-up. - No significant differences for either group over time on POMS, CES-D or STAI. - Between groups – showed no significant differences for pain. - Significant reduction in pain-related distress in favour of MPI. - Significant difference in POMS post treatment but not at follow-up. - No significant differences for STAI and CES-D.	time (0.35 to 0.62). Small effects sizes (0.20 to 0.27) were found for the MBSR on the physical subscale of the SF-12, whereas only minimal effect sizes were found for the control. Small effect sizes were found for the MBSR group for anxiety at 3 and 6 month post (0.2 and 0.25), whereas only minimal effect sizes were computed for the control Minimal to small effect sizes were calculated for both groups on the POMS and CES-D (0.06 to (0.23). Effect sizes for between groups findings demonstrated weak effect sizes for the difference between groups on all variables (0.04 to 0.13).

ACT =Acceptance and Commitment Therapy, AIMS-2 = Revised Arthritis Impact Measurement Scales, AL = Activity Limitations, APT = Active Physical Therapy, ASES = Arthritis Self-Efficacy Scale, ASMP = Arthritis Self-Management Programme, BAT = Behavioral Approach Test, BDI = Beck Depression Inventory, BF = Biofeedback, BPI = Wisconsin Brief Pain Inventory, BT = Behavioural Therapy, C = Control, CBT = Cognitive Behavioural Therapy, CES-D = The Center for Epidemiological Studies Depression Scale, CDSMP = Chronic Disease Self-Management Programme, CHIP = Checklist for Interpersonal Pain Behavior, CPAQ = Chronic Pain Acceptance Questionnaire, CPSES = Chronic Pain Self-Efficacy Scale, CSQ = Coping Strategies Questionnaire, CT = Combined Treatment, DAS = Disease Activity Score, DHQ = Dutch Hyperventilation Questionnaire, EC = Education Control, ED = Education Discussion Group, FFMQ = Five Facet Mindfulness Questionnaire, FIQ = Fibromyalgia Impact Questionnaire, FIQ – R = Fibromyalgia Impact Questionnaire – Revised, FMI = Freiburg Mindfulness Inventory, FSS-III = Fear Survey Schedule, FSS-III-R = Fear Survey Schedule Revised, GSQ = Giessen Complaint Questionnaire, HADS = Hospital Anxiety and Depression Scale, HAI = Health Assessment Instrument, HAQ = Health Assessment Questionnaire, HD = Health Distress, HRLS = Health Related Life Satisfaction Scale, HRQoL (PLC) = Health-Related Quality of Life (Quality of Life Profile for the Chronically Ill), GPQ DSF = German Pain Questionnaire DSF, I = Intervention, IPCBT = In-patient Cognitive Behavioural Therapy, MAAS = Mindful Attention Awareness Scale, MBSR = Mindfulness Based Stress Reduction, MMPI = Minnesota Multiphasic Personality Inventory, MOCI = Maudsley Obsessive Compulsive Inventory, MOS SF-36 = Medical Outcome Study Short Form-36, MPI-I = Multidimensional Pain Inventory, MPLC = Multidimensional Pain Locus of Control Questionnaire, MPQ = McGill Pain Questionnaire, MPQ –SF = McGill Pain Questionnaire – Short Form, MT = Maintenance Training, NHQ = Nijmegen Hyperventilation Questionnaire, NRS = Numerical Rating Scale, OPCBT = Out-patient Cognitive Behavioural Therapy, PANAS = Positive and Negative Affect Scale, PASS = Pain Anxiety Symptoms Scale, PBS = Pain Behavior Scale, PCL = Pain Cognition List, PCQ = Pain Cognitions Questionnaire, PCS = Pain Catastrophising Scale, PDI = Pain Disability Index, POMS = Profile of Mood States, PPS = Pain Perception Scale, PSQI = Pittsburgh Sleep Quality Index, PWBS = Psychological Well-Being Scale, QOLS = Quality of Life Scale, RADAR = Rapid Assessment of Disease Activity in Rheumatology, RMDQ = Roland and Morris Disability Questionnaire, SC = Standard Care, SCL-90-R = Symptom Checklist-90-Revised, SEMCD = Self-Efficacy for Managing Chronic Disease, SES = Socio-Economic Status, SIP = Sickness Impact Profile, SMS = Symptom Monitoring Support, SNDCI = Stone and Neale's Daily Coping Inventory, SOPA = Survey of Pain Attitudes, SPPB – Short Physical Performance Battery, S-RGH = Self-Rated Global Health, SRT = Symptom Rating Scale, SSQ = Stanford Sleep Questionnaire, STAI = State Trait Anxiety Inventory, STRESS = Cohen's Perceived Stress Scale, VAS = Visual Analogue Scale, VMPCI = Vanderbilt Multidimensional Pain Coping Inventory, WLC = Waiting List Control

and rheumatoid arthritis (Carson *et al.,* 2006; Pradhan *et al.,* 2007; Sharpe *et al.,* 2001), four studies consisted of general chronic pain sufferers (Thorn *et al.,* 2011; Weatherell *et al.,* 2011; Williams *et al.,* 1996; Wong *et al.,* 2011), one study consisted of patients with a diagnosis of Systemic Lupus Erythematosus (LPE) (Greco *et al.,* 2004), and a further study including patients with non-cardiac chest pain (Klimes *et al.,* 1990).

Quality Ratings

The quality rating scale employed derived an overall quality score for each study, in addition to two subscales scores for treatment quality, and design and methodology quality. Table 2 presents the ratings of each study in order of final quality score, from the highest quality studies to lowest. Scores for overall treatment quality demonstrated a mean and standard deviation for all included studies of 24.64(5.05), for the treatment subscale this was 6.73(1.98) and for the design and method subscale a mean of 18.09(3.74) was demonstrated. For the CBT studies means for overall quality, treatment and design quality were 23.86(5.89), 6.36(2.02) and 17.64(4.43) respectively, and for the third wave intervention studies were 26.33(2.92), 7.44(1.74) and 19.11(2.09). Inter-rater reliability derived an agreement of 97%. Any differential ratings were resolved through discussion between the raters.

The effect sizes calculated for the different outcome measures, in each of the included studies, are presented in table 3. Studies are represented by their quality rating and the type of intervention assessed (third wave approach (A) or cognitive-based approach (C)) in order to observe any trends in terms of the quality of study, therapeutic approach and strength of findings. Furthermore, graphs illustrating the effect sizes produced for the main outcomes of interest, pain intensity (see figure 2), physical functioning (see figure 3) and emotional adjustment, including anxiety (see figure 4) and depression (see figure 5) are presented again in terms of their quality rating.

Table 2: Quality Ratings for Each Study Included for Review: Presented in Order of Quality From Highest to Lowest.

Study	Description of treatment content, rationale + duration	Treatment delivery – manual use and adherence	Staff training and treatment engagement	**Treatment Rating**	Inclusion/ Exclusion criteria	Attrition reporting & bias	Sample description & equivalence	Randomisation, allocation & expectation bias	Outcome measures – psychometric properties	Follow-up – at least 6 months.	Statistical analyses appropriate & adequate	Comparison Group	**Design/ Methodology Rating**	**Overall Quality Rating**
Thorn (2011) 1	3/3 Well explained.	3/3 2 manuals. Evidence of adherence.	3/3 Adequate training. Engagement assessed.	9/9	2/2 Adequate description. Evidence for adherence.	2/3 Refers to consort. Significant differences between groups.	1/2 Adequate description. CBT more depressed.	4/4 Coin toss & independent rater. Treatment credibility assessed.	6/6 Justified, good validity & reliability.	1/1 6 month follow-up.	4/5 Post hoc power met. ITT. Good planning/ reporting results.	2/2 Well-matched education control.	22/25	31/34
Schmidt (2011) 2	3/3 Well explained.	3/3 2 manuals. Evidence of adherence.	3/3 Adequate training. Engagement assessed.	9/9	2/2 Adequate description. Evidence for adherence.	2/3 Refers to consort. Bias not assessed.	2/2 Adequate description. Good equivalency.	3/4 Computer & independent rater. No bias checks.	6/6 Justified, good validity & reliability.	0/1 2 month follow-up.	4/5 Power not met. Analysis and reporting adequate. ITT analysis.	2/2 Well-matched relaxation group.	21/25	30/34
Glombiewski (2010) 3	3/3 Well explained.	3/3 Manual used & evidence for adherence.	2/3 Adequate training. Engagement not assessed.	8/9	2/2 Detailed criteria & evidence for adherence.	3/3 Reference to consort. No evidence of bias.	2/2 Adequate description. Groups equivalent.	3/4 Random number generator & independent rater. No bias check	6/6 Justified & good validity /reliability.	0/1 Only CBT group at 6 month	5/5 Power met. Good planning/ reporting results. ITT.	0/2 No alternate control group.	21/25	29/34
Weatherell (2011) 4	3/3 Well explained.	3/3 Use of manuals & evidence for adherence.	2/3 Specific trial training. Engagement not assessed	8/9	2/2 Adequate description. Evidence for adherence.	3/3 Reference to consort. No attrition bias.	1/2 Adequate. Group differences depression & disease.	3/4 Computer & independent rater. No bias checks.	6/6 Justified & good validity /reliability.	1/1 6 month follow-up.	3/5 No power calculation. Appropriate statistics & reporting. ITT analyses.	2/2 Groups matched for duration.	21/25	29/34

Wong (2011) 5	3/3 Well explained.	2/3 Use of manual, no evidence for adherence.	3/3 Adequate training. Engagement assessed.	8/9	2/2 Adequate description. Evidence for adherence.	1/3 No consort reference. Significant differences between groups.	2/2 Adequate description. Groups equivalent.	4/4 Random number generator & independent rater. Bias checks.	5/6 Justified & mostly reliable/valid.	1/1 6 month follow-up.	4/5 Power not met. Adequate analysis & reporting. ITT analysis.	2/2 Groups matched for duration.	21/25	29/34
Carson (2010) 6	3/3 Well explained.	2/3 Manual used. No evidence for adherence.	3/3 Adequate training. Engagement assessed.	8/9	2/2 Detailed criteria & evidence for adherence.	3/3 Refers to consort. No evidence of bias.	2/2 Adequate description. Good equivalency.	3/4 Random number table & independent rater. No bias checks.	5/6 Justified & mostly valid/ reliable.	0/1 3 month follow-up.	5/5 Power met. Good planning/ reporting of results. ITT analysis.	0/2 W/L control	20/25	28/34
Greco (2004) 7	3/3 Well explained.	3/3 Manual used & adhered to.	3/3 Relevant training. Engagement assessed.	9/9	2/2 Adequate description. Adequate evidence.	2/3 No reference to consort. No evidence of bias.	2/2 Adequate description. Good equivalency.	1/4 No mention independent rater. No bias checks.	5/6 Justified & mostly valid/ reliable.	1/1 9 month follow-up	4/5 Power not met. Good planning/ reporting results. ITT analysis.	2/2 SMS matched for number of sessions.	19/25	28/34
Sharpe (2001) 8	3/3 Well explained.	2/3 Manual used. No evidence of adherence.	1/3 No relevant trial training. Engagement not assessed.	6/9	2/2 Adequate description. Evidence for adherence.	2/3 No reference to consort. No attrition bias.	2/2 Adequate description. Groups equivalent.	3/4 Random number table & independent rater. No bias checks.	6/6 Justified, good validity & reliability.	1/1 6 month follow up.	5/5 Power met. Statstics & reporting appropriate. ITT analysis.	1/2 Standard care.	22/25	28/34
Carson (2006) 9	3/3 Well explained.	3/3 Manual used & evidence of adherence.	3/3 Relevant training. Engagement assessed.	9/9	2/2 Clearly specified. Evidence of adherence.	1/3 Reported - no consort. Attrition rates significantly different.	1/2 Adequate description. No evidence equivalency.	3/4 Random number table & independent rater. No bias checks.	5/6 Mostly justified & valid/reliable.	1/1 Up to 18 month follow-up.	3/5 No power calculation. Good results planning/ reporting. ITT analysis.	2/2 Education control well-matched.	18/25	27/34
Pradhan (2007) 10	3/3 Adequate detail.	0/3 No evidence of manual use	3/3 Adequate training. Engagement	6/9	2/2 Adequate description. Evidence	3/3 Refers to consort. No attrition	2/2 Adequate. Differences not	3/4 Computer & independent rater. No bias checks.	6/6 Justified & valid/ reliable.	1/1 6 month follow-up.	4/5 Power not met. Appropriate	0/2 W/L control.	21/25	27/34

		or adherence.	assessed.		for adherence.	bias.	confounding				statistics & reporting. ITT analysis.			
Smeets (2006a) 11	3/3 Well explained.	0/3 No evidence of manual use or adherence.	3/3 Adequate training. Engagement assessed.	6/9	2/2 Adequate description. Evidence for adherence.	2/3 No reference to consort. No attrition bias.	2/2 Adequate. Differences identified & controlled for.	4/4 Computer & independent rater. Bias checks conducted.	5/6 Justified, mostly valid & reliable.	0/1 Post only.	4/5 Power not met. Appropriate statistics & reporting. ITT analysis.	1/2 Not clear if duration matched.	20/25	26/34
Astin (2003) 12	3/3 Well explained	1/3 Manual for treatment group.	0/3 Training not specified. Engagement not assessed.	4/9	2/2 Clearly specified. Evidence of adherence.	2/3 No reference to consort. No evidence of bias.	2/2 Adequate description. Good equivalency.	3/4 Computer & independent party. No bias checks.	5/6 Justified, reliable & mostly valid.	1/1 6 month follow-up	4/5 Power calculation. Sufficient planning /reporting results. No ITT analysis.	2/2 Education control well-matched.	21/25	25/34
Kole-Snijders (1999) 13	3/3 Well explained	2/3 Manuals used. Adherence not assessed.	2/3 No specific trial training. Engagement assessed.	7/9	2/2 Adequate description. Evidence for adherence.	2/3 No reference to consort. No evidence of bias.	2/2 Adequate description. Good equivalency.	2/4 Inadequate method. Independent rater. No bias checks.	4/6 Justified, mostly valid/ reliable. Not all reported.	1/1 12 month follow-up.	3/5 No power calculation. Appropriate statistics & reporting. ITT analysis.	2/2 BT matched session duration.	18/25	25/34
Sephton (2007) 14	3/3 Well explained.	2/3 Manual used. No evidence adherence.	3/3 Adequate training. Engagement assessed.	8/9	2/2 Adequate description. Evidence for adherence.	3/3 Reference to consort. No attrition bias.	2/2 Adequate description, Good equivalency.	0/4 No description of method. No bias checks conducted.	6/6 Justified, good validity & reliability.	0/1 2 month follow-up.	3/5 Power not specified. ITT analysis. Adequate statistics & reporting.	0/2 No equivalent control.	16/25	24/34
Morone (2009) 15	3/3 Well explained.	2/3 Treatment manuals. No evidence adherence.	3/3 Adequate training. Engagement assessed.	8/9	2/2 Adequate description. Evidence for adherence.	2/3 No reference to consort. No attrition bias.	1/2 Adequate description. Significant age differences.	4/4 Computer & independent rater. Expectancy checks.	6/6 Justified, reliable, & valid.	0/1 4 month follow-up.	0/5 No power calculation. Inadequate analyses & reporting. No	2/2 Education group well-matched.	17/25	23/34

											ITT analysis.			
Barlow (2000) 16	3/3 Well explained.	2/3 Manual. No evidence adherence.	0/3 Training not specified. Engagement not assessed.	5/9	2/2 Clearly specified. Evidence of adherence.	2/3 Attrition reported – No consort. No evidence of bias.	2/2 Adequate description. Good equivalency.	3/4 Pre-generated lists & independent rater. No bias checks.	5/6 Justified mostly valid/reliable.	0/1 4 month follow-up.	3/5 Adequate sample. Power calculation not a priori. Query use of statistics. Good reporting. ITT analysis.	0/2 W/L control	17/25	22/34
Lorig (2005) 17	3/3 Well explained.	0/3 No evidence of manual use or adherence.	1/3 Training not specified. Engagement assessed.	4/9	2/2 Adequate description. Evidence for adherence.	1/3 No reference to consort. Bias not assessed.	2/2 Adequate description. Groups equivalent.	1/4 Random number charts. No independent rater. No bias checks.	5/6 Justified & mostly valid/ reliable. Not all reported.	1/1 6 month follow-up.	5/5 Power met. Appropriate statistics & reporting. ITT analysis.	1/2 Alternate CBT group. Not control.	18/25	22/34
Morone (2008) 18	3/3 Well explained.	2/3 Use of manual. No evidence of adherence.	3/3 Adequate training. Engagement assessed.	8/9	2/2 Adequate description. Evidence for adherence.	2/3 No reference to consort. No evidence of bias.	2/2 Adequate description. Good equivalency.	2/4 Computer randomised. No independent rater. No bias checks.	6/6 Justified, valid/ reliable.	0/1 3 month follow-up.	2/5 No power calculation. Statistics queried. Adequate reporting. ITT analysis .	0/2 W/L Control	16/25	22/34
Vlaeyen (1996) 19	3/3 Well explained	0/3 No evidence of manual use or adherence.	2/3 No specific trial training. Engagement assessed.	5/9	2/2 Adequate description. Evidence for adherence.	2/3 No reference to consort. No attrition bias.	2/2 Adequate description. Groups equivalent.	1/4 No description of method. Expectations assessed.	4/6 Justified, mostly valid & reliable.	1/1 6 & 12 month follow-up.	2/5 Power not met. Appropriate statistics & reporting. No ITT analysis.	2/2 Education group matched.	16/25	21/34
Williams (1996) 20	3/3 Well explained.	2/3 Use of manual. No evidence of adherence.	2/3 Adequate training. No assessment of	7/9	0/2 Inadequate detail re. criteria & adherence.	0/3 Inadequate detail re. attrition.	2/2 Adequate description. Groups equivalent.	1/4 Lack of info re. method. Expectations assessed.	6/6 Justified, valid & reliable.	1/1 1 year follow-up.	2/5 No power calculation. Appropriate statistics &	1/2 OP-CBT not matched for time etc.	13/25	20/34

			engagement.								reporting. No ITT analysis.			
Falcao (2008) 21	3/3 Well explained.	0/3 No manual.	0/3 Training not specified. Engagement not assessed.	3/9	2/2 Detailed criteria & evidence for adherence.	1/3 No reference to consort. Bias not assessed.	2/2 Adequate description. Good equivalency.	1/4 Not described. Allocation concealed. No bias checks.	5/6 Justified & mostly valid/ reliable.	0/1 3 month follow-up.	2/5 No power calculation. Good planning/ reporting results. No ITT analysis.	1/2 Standard care but not well matched.	14/25	17/34
Klimes (1990) 22	2/3 Well explained. Duration not clear.	0/3 No evidence of manual use or adherence.	1/3 No specific trial training. Engagement not assessed.	3/9	1/2 Adequate description. No evidence adherence.	0/3 Inadequate attrition information. Unable to assess bias.	2/2 Adequate description. Good equivalency.	0/4 Inadequate description. No bias checks.	2/6 Mainly justified. Not valid, mostly reliable.	0/1 4-6 month. Not all 6 months.	1/5 No power calculation. Appropriate statistics. Inadequate reporting. No ITT analysis.	0/2 W/L control.	6/25	9/34
BT = Behavioural Therapy, CBT = Cognitive Behavioural Therapy, ITT = Intention to Treat, OP-CBT = Outpatient Cognitive Behavioural Therapy, SMS = Symptom Monitoring Support, W/L = Waiting List														

Table 3: Effect Sizes for the Outcomes from Each Study Presented According to the Associated Quality Rating

Outcome	Analysis	Minimal ES (<0.2)	Small ES (≥0.2)	Medium ES (≥0.5)	Large ES (≥0.8)
Main Dependent Variables Included within the Studies to Assess Outcomes from Intervention					
Pain severity	Within	1 Study (5 A)	3 Studies (8 C, 16 C, 17 C , 19 C)	6 Studies (1 C, 2 A, 5 A, 7 C, 12 A 20 C)	1 study (21 C)
	Between	1Study (15 A)	2 Studies (6 A, 18 A)	3 Studies (3C, 11C, 19C)	1 Study (9 C)
	Interaction		1 Study (8 C)		
Physical Functioning	Within	2 Studies (4 C, 17 C)	3 Studies (2 A, 4 A, 7 C)	3 Studies (1C,10A, 12A)	2 Studies (20 C, 21 C)
	Between	1Study (4 C A)	2 Studies (3 C, 18 A)	2 Studies (6 A, 11 C)	1 Study (13 C)
Depression	Within	1 Study (19 C)	5 Studies (1C, 4A, 5 A, 4C, 16C)	2 Studies (7 C, 12 A)	2 Studies (20 C, 11 C)
	Between	3 Studies (4 C A, 5 A, 19C)	4 Studies (3C, 10A, 11C, 16C)		2 Studies (6 A, 14 A)
	Interaction		1 Study (10 A)	1 Study (1 C)	1 Study (8 C)
Anxiety	Within	1 Study (16 C)	2 Studies (4 C, 4 A, 5 A)	2 Studies (20 C, 21 C)	
	Between	2 Studies (4 C A, 5A)	1 Study (16 C)	1 Study (6 A)	
	Interaction			1Study (8 C)	
Psychological Distress	Within			1 Study (5 A)	
	Between	1 Study (5A)		1 Study (10 A)	
	Interaction			1 Study (10 A)	
Negative Affect	Within	1 Study (16 C)			
	Between	1 Study (16 C)			
	Interaction	1Study (13 C)			2 Studies (9C, 13 C)
Positive Affect	Within		1 Study (16 C)		
	Between		1Study (16 C)		1Study (9 C)
Other Dependent Variables and/or Process Variables Influencing Intervention Outcomes from the Studies					
Mindfulness	Within		1 Study (15 A)		
	Between		1 Study (10 A)		
	Interaction		1 Study (10 A)		
Pain Self-efficacy	Within		1Study (16 C)		
	Between		1 Study (16 C)		
Self-efficacy	Within		2 Studies (16 C, 17 C)		2 Studies (7 C, 20 C)
	Between		1Study (16 C)		
Fear	Within	1 Study (19 C)			
	Between				1Study (19 C)
Catastrophising	Within	1 Study (19 C)		1 Study (1C)	1 Study (20 C)
	Between		1 Study (11 C)	2 Studies (6 A, 19 C)	
	Interaction			1 Study (1 C)	
Pain Control	Within			1Study (19 C)	
	Between	1 Study (11 C)			
Acceptance	Within		1 Study (4 C, 4 A)		
	Between	1 Study (4 C A)		1 Study (6 A)	1 Study (18 A)
Coping	Between				3 Studies (3 C, 9 C, 13C)
	Interaction	1 Study (13 C)		1 Study (8 C)	

Notes: Number = Study quality rating from Table 2. C = Cognitive-based intervention. A = Third Wave intervention.

Figure 2: Graph Showing the Effect Sizes from All Studies Assessing Pain Severity and the Corresponding Quality Rating of the Article

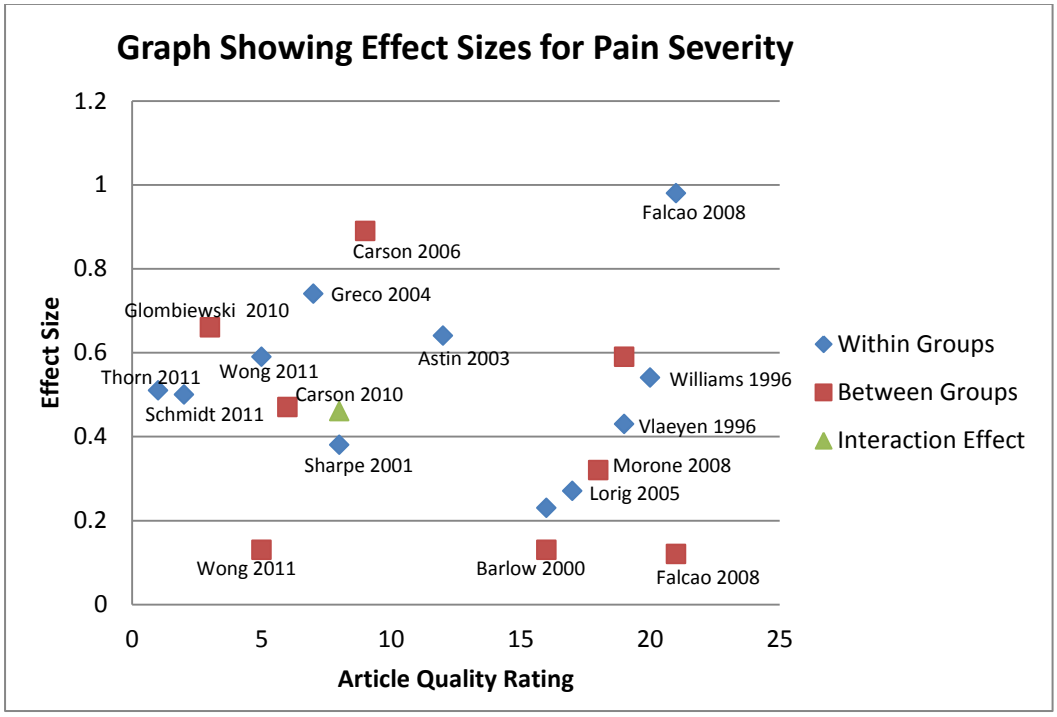


Figure 3: Graph Showing the Effect Sizes from All Studies Assessing Physical Functioning and the Corresponding Quality Rating of the Article

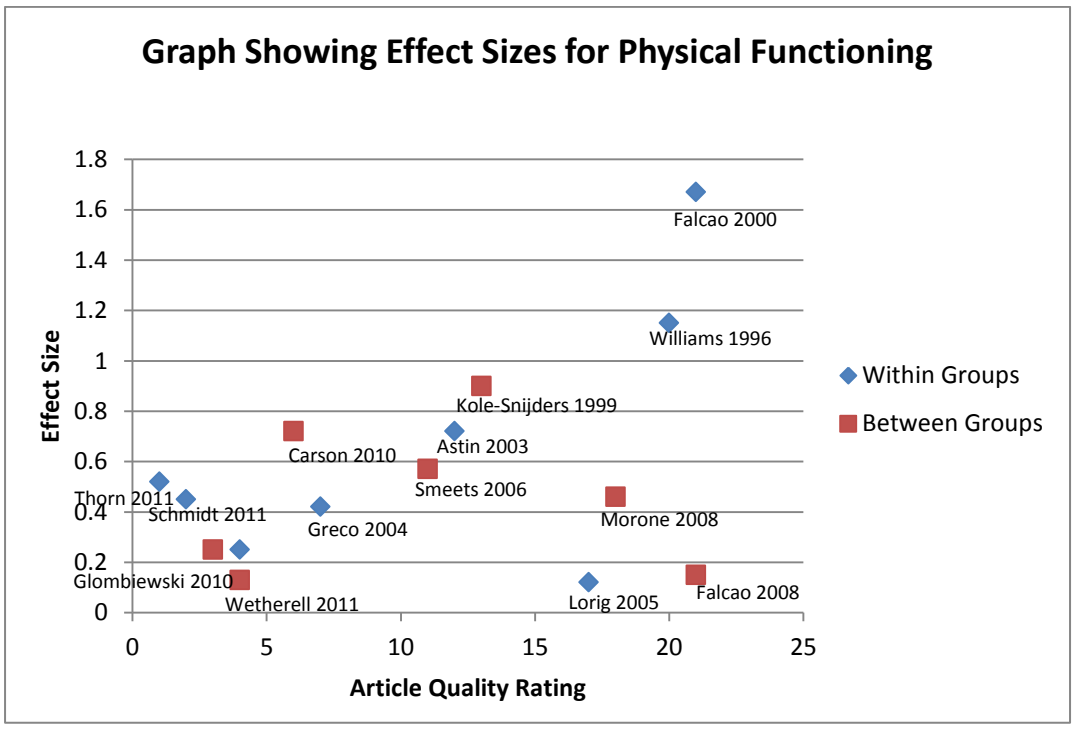


Figure 4: Graph Showing the Effect Sizes from All Studies Assessing Anxiety and the Corresponding Quality Rating of the Article

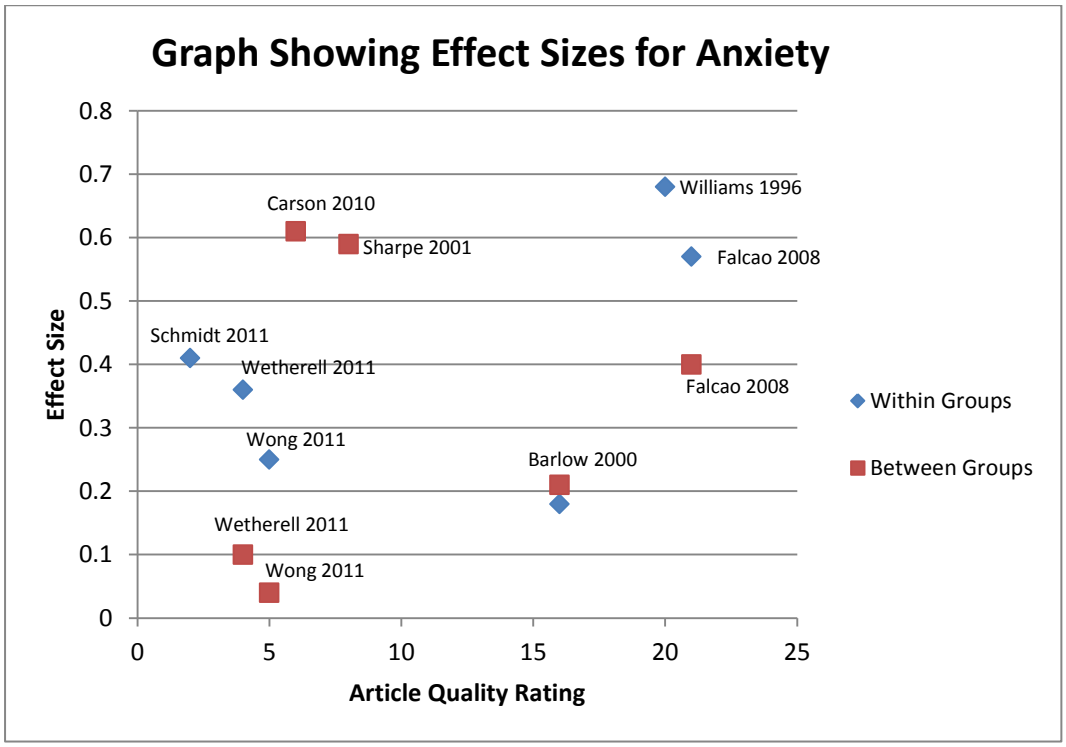
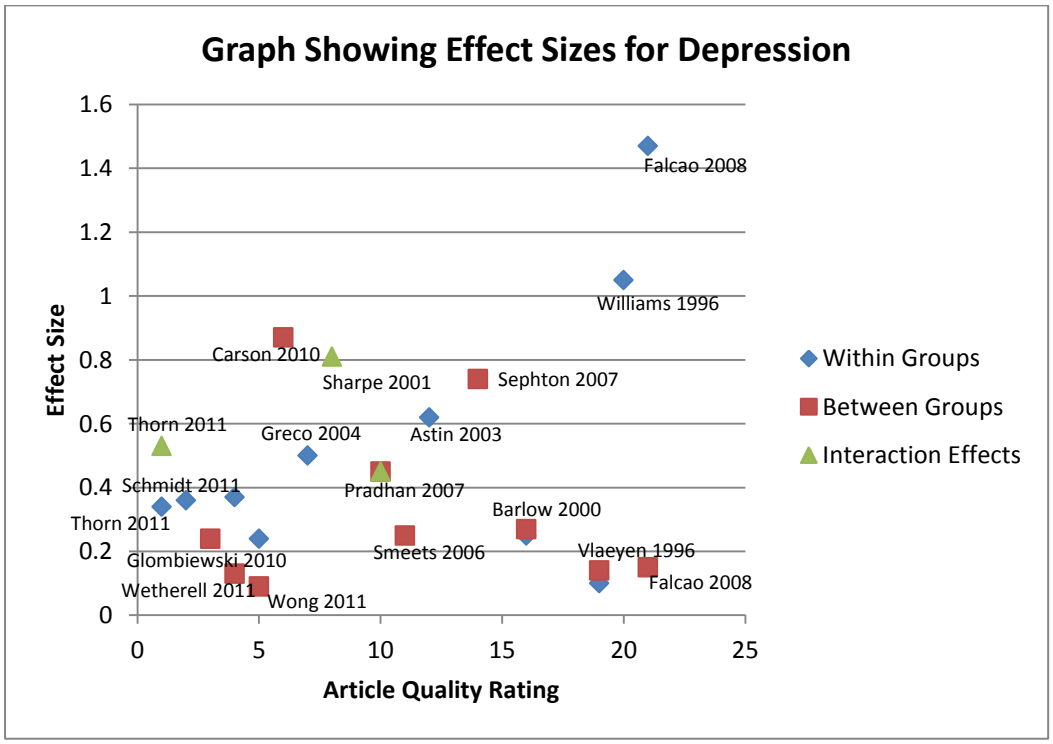


Figure 5: Graph Showing the Effect Sizes from All Studies Assessing Depression and the Corresponding Quality Rating of the Article



The graphs demonstrate the absence of a trend towards higher quality studies producing larger effect sizes for within group and between group differences, for pain, anxiety, depression and physical functioning. Two studies were shown to consistently achieve large effect sizes, despite being given a low quality rating. It should be noted that in the first study the effect sizes were equally as large for the standard care control group, and between group effect sizes indicated minimal to small effects (Falcao et al., 2008), and the second study employed an inpatient intervention group (Williams et al., 1996), which could explain larger effect sizes despite reduced quality of the study.

Excluded Studies

Of the 130 RCT's identified as investigating one of the named approaches within an adult pain population, 108 were excluded based on the set criteria. Thirteen articles were excluded based on low sample size which meant that there were fewer than ten participants in each arm of the study for analysis (Applebaum, Blanchard, Hickling & Alfonzo*,* 1988; Castel, Salvat, Sala & Rull*.,* 2009; Cook, 1998; Dahl, Wilson & Nilsson*,* 2004; Kerns*,* Turk, Holzman & Rudy, 1986; Nicholas, Wilson & Goyen, 1991; Nicholas, Wilson & Goyen, 1992; Peters & Large, 1990; Plews-Ogan, Owens, Goodman, Wolfe & Schorling, 2005; Price, McBride, Hyerle & Kivlahan, 2007; Spence., 1991; Wicksell, Ahlqvist, Bring, Melin & Olsson, 2008; Zautra *et al.*, 2008) and a further 22 were excluded because the participants did not fit the criteria for chronic pain, or this was not specified within the study (Asenlof, Denison & Lindberg, 2005; Astin, 1997; Barsky *et al.*, 2010; Buzcewicz *et al.*, 2006; Esmer, Blum, Rulf & Pier, 2010; Haldorsen, Kronhom, Skouen & Ursin, 1998; Jensen, Bergstrom, Ljungquist, Bodin & Nygren, 2001; Jensen, Bergstrom, Ljungquist & Bodin, 2005; Jonsbu, Dammen, Morken, Moum & Martinsen, 2011; Kaapa, Frantsi, Sarna & Malmivaara, 2006; Lamb *et al.*, 2010; Liedl *et al.*, 2011; Linton & Andersson, 2000; Linton, Boersma, Jansson, Svard & Botvalde, 2005; Marhold, Linton & Melin, 2001; Mayou *et al.*, 1997; Menzel & Robinson, 2006; Moore, Von, Cherkin, Saunders & Lorig, 2000; O'Leary, Shoor, Lorig & Homan, 1988; Spinhoven, Van der Does, Van & Van Rood, 2010; Van Peski-

Oosterbaan, Spinhoven, Vand der Does, Bruschke & Rooijmans, 1999; Watt, Stewart, Lefaivre & Uman, 2006).

No attempts to control for researcher blinding resulted in 29 studies being excluded (Altmaier, Lehmann, Russell & Weinstein, 1992; Basler, Jakle & Kroner-Herwig, 1997; Ersek, Turner, Cain & Kemp, 2003; Ersek, Turner, McCurry, Gibbons & Kraybill, 2008; Evers, Kraaimaat, van Riel, de Jong, 2002; Fairbank *et al.*, 2005; Hammond & Freeman, 2006; Johansson, Dahl, Jannert, Melin & Andersson, 1998; Johnson *et al.*, 2007; Kraaimaat, Brons, Geenen & Bijlsma, 1995; Lera *et al.*, 2009; Liebing, Pfingsten, Bartmann, Rueger & Schuessler, 1999; McCarberg & Wolf, 1999; Newton-John, Spence & Schotte, 1995; Parker *et al.*, 1988**;** Parker *et al.*, 1995; Parker *et al.*, 2003; Redondo *et al.*, 2004; Rhee *et al.*, 2000; Smarr *et al.*, 1997**;** Spence, 1989; Strong, 1998; Thieme, Flor & Turk, 2006; Turner & Clancy, 1988; Turner & Jensen., 1993; Turner-Stokes *et al.*, 2003; Van Koulil *et al.*, 2010; Vlaeyen, Haazen, Shuerman, Kole-Snijders & van Eek, 1995; Williams *et al.*, 2002), twelve of which lacked clarity and were excluded either by email response from the author or when no response was obtained.

A further ten studies were excluded due to the predominance of headache and/or facial pain within their sample (Dworkin *et al.*, 2002; Flor & Bilbaumer, 1993; Litt, Shafer, Ibanez, Kreutzer &Tawfik-Yonkers, 2009; Litt, Shafer & Kreutzer, 2010; Masheb, Kerns, Lozano, Minkin & Richman, 2009; Pato *et al.*, 2010; Pilowsky, Spence, Rounsefell & Forsten, 1995; Thorn *et al.*, 2007; Turner, Mancl & Aaron, 2005; Turner, Mancl & Aaron, 2006), and seventeen studies were excluded due to failing to provide an accurate representation of the named treatment. Four of these studies were excluded due to a lack of clarity in the description of the intervention and/or the description provided was not representative of the therapy that had been specified (Becker, Sjorgen, Bech, Olsen & Eriksen, 2000; Bendix, Bendix, Lund, Kirkbak, & Ostenfeld, 1997; Bradley *et al.*, 1987; Freeman, Hammond & Lincoln, 2002), seven provided

treatment in the form of a self-help guide in a book or on the internet (Johnston, Foster, Shennan, Starkey & Johnson, 2010; Lorig, Ritter, Laurent & Plant, 2008; Newcomer, Vickers Douglas, Shelerud, Long & Crawford, 2008; Soderlund & Lindberg, 2001; Strauss *et al.*, 1986; Thorsell *et al.,* 2011; Williams *et al.*, 2010), two provided treatment via telephone consultation (Ang, Chakr *et al.,* 2010; Ang, Bair, 2010) and four consisted of only a single session (Brox *et al.*, 2003; Christiansen, Oettingen, Dahme & Klinger, 2010; Esler *et al.*, 2003; Keller *et al.*, 2004).

Additionally seven studies were excluded due to pain being secondary to a malignant and/or other condition that could potentially affect physical and/or psychological functioning significantly (Abbott,Tyni-Lenne & Hedlund, 2010; Currie, Wilson, Pontefract & DeLaplante, 2000; Dalton, Keefe, Carlson & Youngblood, 2004; Edinger, Wohlgemuth, Krystal & Rice, 2005; Evans, Fishman, Spielman & Haley, 2003; Jungquist *et al.*, 2010; Teixeira., 2010). Of the remaining studies, seven did not include a standardised measure of physical functioning or psychological status (Busch, Bodin, Bergstrom & Jensen, 2011; Day, Thorn & Kapoor, 2011; Ektor-Anderson, Ingvarsson, Kullendorff & Orbaek, 2008; Heapy *et al.*, 2005; Puder, 1988; Schweikert *et al.*, 2006; Wigers, Stiles & Vogel, 1996), two provided a protocol for currently on-going research (Garcia-Campayo *et al.*, 2009; Rodriguez-Blanco *et al.*, 2010), and one study which initially appeared to consist of an adult population, actually included those aged under 18 (Thomas, Dixon & Milligan, 1999).

Discussion

Of the studies selected for review, it is evident that a higher number of these evaluate a CBT approach, which therefore suggests more studies of a higher quality are available within this area. A high proportion of the identified studies also assess a mindfulness-based intervention, however only one study evaluating the efficacy of an ACT intervention was suitable for review, highlighting a need for further research in this area. Of those included, quality ratings for the studies selected indicate a similar

overall level of quality for the cognitive-based and third wave intervention studies. Limitations, however, in terms of treatment quality and methodology exist to an extent across all of these studies, which could influence the range of findings in efficacy for these interventions.

The finding regarding lower numbers of high quality ACT studies being identified, could be due to the fact the ACT is still in the process of establishing itself as a valid intervention and therefore constraints with regard to funding, limit the current scientific status of this approach. As demonstrated in a recent study, a significant discrepancy in the level of funding successfully accredited to research assessing the efficacy of ACT interventions compared to studies evaluating CBT has been highlighted, resulting in research of a considerably smaller scale being conducted to support ACT (Gaudiano, 2009). The current position of ACT should therefore be appreciated when considering the findings of this systematic review.

Overview of the Effect Sizes for Specific Outcome Variables

This review aimed to assess the efficacy of each treatment in improving pain, physical functioning and on psychological variables. An overview of the effect sizes shows that generally small to large effects were found across both treatments for pain, with the mindfulness studies, however, demonstrating only small effects. For physical functioning, again a wide range of effect sizes can be observed from minimal effects to large effects.

The most commonly assessed psychological variables from the studies selected included depression, anxiety, self-efficacy, catastrophising and acceptance. Effect sizes for depression varied from minimal effects to large effects across both treatment approaches, with the majority of studies, however, demonstrating small effects on this variable across time. Although fewer studies assessed anxiety and catastrophising, the results demonstrated a similar range of effect sizes again from no effects to large. Self-efficacy was only measured within studies evaluating a CBT approach, however, within these,

effects were consistently observed, small to large across the studies. The two studies, however, exhibiting small effects were characterised by methodological constraints which will be discussed in more detail later in this review (Barlow *et al.*, 2000; Lorig *et al.*, 2005). Furthermore, acceptance was also found to have consistent effects for group across time, predominantly within the mindfulness studies, with the exception of one study (Wetherell *et al.*, 2011), all demonstrating small to large effect sizes, across time. When considering the effect sizes depicted in Table 3 and in Figures 2 to 5, it can be concluded that there was no trend observed in terms of higher quality studies generating greater effect sizes.

Intervention versus Waiting List Control or Standard Care Group

Of the studies selected, 11 compare a cognitive-based approach to either a waiting list control or standard care control group. Studies where effect sizes were only calculable for within group analyses demonstrated a range of small to large effects for pain, pain control, anxiety, catastrophising, depression, self-efficacy, functioning, and perceived stress for the CBT-based intervention over time (Greco *et al.*, 2004; Falcao *et al.*, 2008; Vlaeyen *et al.*, 1996; Williams *et al.*, 1996).

Significant between groups differences for CBT versus standard care in one study on psychological components at post and follow-up, and for physical functioning at post treatment only, were found. However, effects sizes could not be computed given the data available (Greco *et al.*, 2004). Although these results are promising and are in support of CBT, each of the studies showed variation in terms of improvements in each specific outcome, with the exception of self-efficacy which was measured in two of the studies, and had a consistently large effect in both (Greco *et al.*, 2004; Williams *et al.*, 1996).

In contrast, Falcao et al. (2008) and Vlaeyen et al. (1996) found comparable effects sizes across outcome variables for a standard care and waiting list comparison group with the exception of anxiety. Limitations, however, for all of these studies include a lack of evidence to conclude that adequate randomisation strategies had been performed and the absence of a power calculation being made or

being met in terms of sample size, which increases the risk of a Type 2 error occurring. With the exception of Greco *et al.* (2004), none of the CBT interventions were manualised and therefore treatment content was not monitored which presents further difficulty in generalising the result to the chronic pain population.

A further six studies investigating between groups comparisons for a CBT group and a standard care or waiting list control group found a range from small to large effects across a number of variables including pain, physical functioning and varying psychological components (Barlow *et al.*, 2000; Carson *et al.,* 2006; Glombiewski *et al.*, 2010, Kole-Snijders *et al.,* 1999; Sharpe *et al.,* 2001; Smeets, Vlaeyen, Hidding *et al.,* 2006). In terms of the long-term benefits, medium effects on anxiety, coping strategies and depression were maintained at 6 month follow-up in one study (Sharpe *et al.*, 2001), and medium to large effects were maintained at 18 month follow-up on pain, coping efficacy, and on negative and positive affect for another study (Carson *et al.*, 2006).

Given the lack of consistency in terms of effect sizes for all of the variables across the studies, this makes it difficult to derive concrete conclusions regarding the effects of CBT within one specific area of adjustment to pain. Despite a number of these studies failing to provide an a priori power calculation (Barlow *et al.*, 2000; Carson *et al.*, 2006; Kole-snijders *et al.*, 1999) or failing to obtain a sufficient sample size (Smeets, Vlaeyen, Hidding *et al.*, 2006), quality was generally of an acceptable level with all scoring 25 and over on the quality rating scale with the exception of one study (Barlow *et al.,* 2000).

Additionally, from the selection process, five studies comparing mindfulness to a standard care comparison group or waiting list control were identified. Within group analyses for one study yielded small to medium effect sizes across time for the mindfulness intervention on functioning, depression, anxiety and two measures of pain, affective and sensory, the latter of which did not reveal a significant change across time. In contrast, only small effects were identified for the waiting list group on the pain sensory measure only (Schmidt *et al.,* 2011).

In comparison to a waiting list control, between groups analyses have also found varied effects sizes across a range of variables including functioning, acceptance, pain, psychological distress, wellbeing and depression (Carson *et al.,* 2010; Morone *et al.*, 2008; Pradhan *et al.*, 2007; Sephton *et al.*, 2007). Small to medium effects were shown to be maintained for depression, psychological distress, wellbeing and on a measure of mindfulness at 6 month follow-up (Pradhan *et al.*, 2007). The only consistently large effect of group was found for the Activity Engagement subscale of the CPAQ which was assessed within two of the studies (Carson *et al.*, 2010; Morone *et al.*, 2008). Of these studies, however only one documented that sufficient power had been met (Carson *et al.*, 2010).

In summary, studies comparing cognitive-based and third wave interventions to waiting list and standard care control groups have demonstrated mixed results across all outcome measures. More research is required to provide further support for the consistently large effect on the Activity Engagement acceptance subscale for mindfulness. Although results are varied, generally findings are promising for both treatment groups on pain, functioning and psychological components. Study quality constraints however, also limit the ability to generalise these findings to the larger population.

Active Control Group Comparisons

Studies that employ an active control group that matches the intervention group for duration and number of sessions help to control for factors including group support and contact with a professional, which may influence outcomes. This therefore allows the direct effects of the therapeutic content to be evaluated. In comparison with an education control group, significant improvements and large effect sizes in favour of CBT were found on pain, coping efficacy, negative affect and positive affect at post treatment and large effects were also maintained at 18 month follow-up (Carson *et al.,* 2006).

In a similar study a significant finding was observed for within group analyses of depression and catastrophising for CBT, indicating small to medium effects sizes in comparison with an education group demonstrating minimal effects (Thorn *et al.,* 2011). Significantly higher baseline depression

levels in the CBT group, however may have influenced this finding. Equivalent findings were observed for both groups on disability pain and quality of life measures. A significant interaction effect for depression and catastrophising in favour of the CBT group was also observed, however, only within the completer analysis and not when employing an intention to treat analysis.

Within group analyses for a less robust study in terms of methodological quality (as discussed previously), found similar small to medium effects for both groups across time on pain and psychological variables (with large effects of pain for the control group) (Vlayen *et al.*, 1996). The only significant difference was for the variable fear in favour of the education control group, which the authors suggest could be due to participants within this group being offered more individual support.

Alternatively, within group analyses for a study supporting CBT in comparison with a Symptom Monitoring Support group found medium to large effect sizes for CBT on pain, functioning and psychological variables (depression, perceived stress and self-efficacy) at post treatment, and small to medium at 9 month follow-up. However, only small effects were identified for the control on pain at post treatment, and pain depression and perceived stress at follow-up (Greco *et al.,* 2004).

In contrast, similar small to medium effect sizes for within group analyses for both CBT and an Active Physical Therapy group and a significant improvement in depression for the control group, did not provide support for CBT (Smeets, Vlaeyen, Hidding *et al.*, 2006). An investigation of mediating factors within this study found no mediating role of pain control for treatment outcome. However, a mediating effect of catstrophising was identified for the significant improvements in functioning, pain and pain complaints for both active treatments and for reduction in depression for the APT group only (Smeets, Vlaeyen, Kester *et al.,* 2006). Although quality of this study was generally good, potential constraints as mentioned previously, can compromise generalisation of these findings to the wider population.

Studies investigating the efficacy of third wave interventions in comparison with an active control have also found varying results. Three studies comparing mindfulness to an Educational control group failed

to find significant differences on pain, functioning and psychological variables across time (Astin *et al.*, 2003; Morone *et al.*, 2009; Wong *et al.,* 2011). With the exception of a medium effect of depression for Mindfulness at post treatment, and a small effect for the educational control (Astin *et al.*, 2003), and small effect sizes being observed for anxiety in the mindfulness group in comparison to minimal effects within the control (Wong *et al.,* 2011), effect sizes were similar for both groups in within group analyses across all variables in both studies. However, minimal improvement in the Morone *et al.* (2009) study, in terms of physical functioning, could be due to a ceiling effect whereby, a high baseline level of functioning within the mindfulness group led to little scope for improvement. Other constraints including lack of power should also be considered.

Significant improvements on a mindfulness measure, however, demonstrate support for a mindfulness intervention in comparison to a relaxation group (Schmidt *et al.*, 2011). Within group effects sizes showed small to medium effects for the mindfulness group across all measures of pain, functioning and psychological variables, whereas only a small effect was identified for the relaxation group on the pain affective subscale. This study demonstrated good quality ratings for treatment and methodology, providing support for the efficacy of mindfulness in comparison with relaxation.

In summary, mixed findings are observed for the efficacy of both cognitive-based and third wave approaches in comparison with an active treatment. Quality limitations however, may be responsible for a lack of significant effects in favour of the treatment conditions. CBT showed promising results in comparison with an education control (Carson, *et al.,* 2006) and versus a symptom monitoring group (Greco *et al.,* 2004), but not with an Active Physical Therapy Group (Smeets, Vlaeyen, Hidding *et al.*, 2006). For mindfulness, although comparisons to an education control did not support the intervention (Astin *et al.*, 2003; Morone *et al.*, 2009), comparisons to a relaxation group were particularly promising (Schmidt *et al.*, 2011). This highlights that the unique principles underlying mindfulness have a role in improving pain adjustment, over and above the potential relaxation component of the treatment.

Comparison with an Alternative Psychological Treatment

A study comparing a cognitive behavioural approach within a chronic low back pain population to a well-matched behavioural intervention, revealed no significant group by time interaction with a minimal effect size observed for this interaction (Kole-Snijders *et al.*, 1999). With the exception of a power calculation, this study performed well in terms of quality, assessing both treatment expectations and adherence. In addition, Glombiewski *et al.* (2010), found that the inclusion of a Biofeedback component did not improve the benefits associated with a CBT intervention, with comparable effect sizes from small to medium being observed for within groups analyses for the CBT and CBT plus BioFeedback conditions. This therefore suggests that significant improvements between the active treatments and waiting list control were associated specifically with the CBT content.

In terms of delivering CBT, an inpatient setting was found to be significantly superior with small to large effect sizes, on a range of pain functioning and psychological adjustment measures, in comparison to an outpatient delivered CBT intervention (Williams *et al.*, 1996). In addition a disease specific CBT-based programme was significantly more effective than an intervention aimed at chronic conditions in general (Lorig *et al.*, 2005). Small within group effects of the arthritis specific CBT intervention were observed on pain and self-efficacy at 4 and 12 months, whereas, only a small effect of self-efficacy was observed at 12 months within the chronic disease oriented condition. Methodological limitations should be considered for both studies. The absence of a manual within the latter study means standardised treatment procedures may not have been adhered to. A lack of information regarding randomisation and insufficient power due to high attrition further limit the findings.

A final study comparing both a cognitive-based approach and a third wave approach found no significant interaction effects of group by time (Wetherell *et al.*, 2011). Within groups analyses revealed small effects of time for the ACT group on functioning, depression, anxiety and acceptance. Similar small effects were demonstrated for the CBT group, with the exception of functioning that yielded no

effects across time. Further, no mediating effects of perceived control or acceptance were observed for either group. Generally high quality ratings for this study were identified, with the exception of a lack of power calculation, which could mean the occurrence of a Type 2 error if the sample size was inadequate. This study would also have benefitted from a control group in order to assess the effect of time on outcome variables.

In summary, CBT does not present as superior or inferior to a behavioural intervention group and is also comparable with an ACT intervention, although more research is required. Findings also highlighted the potential value of a more intensive delivery of CBT that is disease specific however more high quality research is required to obtain findings which can be applied to the pain population in general.

Clinical Implications and Future Directions

Although mixed results for the efficacy of cognitive and third wave approaches have been demonstrated, there are many studies that have shown promising findings for these interventions within a chronic pain population. Although variable from study to study, generally improvements have been observed on measures of pain, physical functioning and psychological components, highlighting a beneficial effect of treatment and a possible link between the psychological and physical experience of pain. Consistent findings in within groups analyses for self-efficacy (Greco *et al.*, 2004; Williams *et al.*, 1996), demonstrated the benefits of CBT in improving this factor, in line with other research (Asghari & Nicholas, 2001). The effect of self-efficacy in general is consistent with the theoretical principles underlying CBT approaches, whereby cognitive and behavioural aspects can result in more helpful thinking patterns and beliefs regarding pain and the individual's own ability to cope.

The consistent effects of acceptance across the studies which predominantly assessed mindfulness approaches (Carson *et al.*, 2010; Morone *et al.*, 2008) are coherent with the theory underlying this

approach, whereby increased acceptance of thoughts, beliefs, and emotions regarding pain, as well as the pain sensation itself is a predicted outcome which is also associated with improvement in pain adjustment (Gardner-Nix, Backman, Barbati & Grummitt, 2008; Kabat-Zinn, 1982). This was however, for the Activity Engagement scale within the CPAQ, whereas no effects or only small effect sizes, were observed for the Willingness subscale.

This is also concurrent with other research that has questioned the utility of the Pain Willingness subscale (Nicholas & Asghari, 2006). Furthermore, in contrast with other research (McCracken & Eccleston, 2006; McCracken, Vowles & Gauntlett-Gilbert, 2007; Vowles *et al.,* 2007), the one study investigating the mediating role of acceptance found no evidence of mediation for the CBT or ACT interventions (Wetherell *et al.*, 2011). Further research, however, amending methodological constraints is required in order to support this finding.

Few of the identified studies however, investigated the role of mediators in influencing the desired outcomes, with the exception of one highlighting the mediating effects of catastrophising on pain, pain complaints and functioning, within a CBT group providing support for the CBT theory and principles (Smeets, Vlaeyen, Kester *et al.*, 2006). A lack of significant improvement in depression, however, for the CBT group is inconsistent with cognitive theory that posits that a reduction in specific patterns of thinking distortions improves mood.

Within the same study, however, similar effect sizes were identified on depression within the CBT and Active Physical Therapy (APT) group and a significant difference was observed for the APT group in comparison with the waiting list control. This suggests that the lack of significant findings for change in depression within the CBT group could be due to methodological constraints and should the sample size have been greater then significant findings may also have been present for the CBT group. Similar effect sizes within this study to an APT group in comparison with a waiting list control (Smeets, Vlaeyen, Hidding *et al.*, 2006), and within a further study, no effects in terms of the difference between

CBT and a behavioural approach (Kole-Snijders *et al.*, 1999), question the utility of the cognitive aspect of treatment over and above changing specific behaviours and increasing activity, which is consistent with some views (Jacobsen *et al.,* 1996).

Although there have been more RCT studies conducted to investigate CBT within chronic pain in comparison with other approaches, further studies are still required that assess both cognitive and third wave approaches within this area, which address some of the methodological constraints highlighted within this review and include sufficient sample size. In terms of comparing the efficacy of cognitive and third wave approaches, no definitive results have been identified from this review, with the one study directly comparing ACT and CBT finding no significant differences (Wetherell *et al.*, 2011).

The majority of studies assessed within this review, however, are characterised by a number of design limitations, including lack of power or absence of an a priori calculation, lack of description of methods of randomisation and a lack of monitoring of treatment content via manualisation and supervision, which should be considered when interpreting the results. Finally, within this field of research, benefits would also be derived from RCT's which also assess the potential mediating role of different psychological variables in achieving the desired outcomes. This would be valuable in providing further evidence to support cognitive and third wave approaches within chronic pain, and help increase understanding with regard to the specific aspects of both of these treatments that produce improvement in adjustment to pain.

Review Limitations

Criteria for selection within this review were more stringent than previous systematic reviews within the same area. Although this meant that only the highest quality studies were being considered and therefore those that deliver the most meaningful findings, this did limit the studies being reviewed to primarily CBT and mindfulness interventions. Consequently, a few RCT's demonstrating potentially promising findings in support of ACT could not be considered (Dahl *et al.*, 2004; Johnston *et al.*, 2010;

Wicksell *et al.*, 2008). Furthermore, the inclusion, solely of RCT's also presents possible limitations. Although RCT's are considered to be the most reliable form of scientific evidence due to their ability to minimise selection bias and confounding, the unnatural and manufactured setting of most RCT trials, can limit external validity (Rothwell, 2005).

Furthermore, this review was limited to published studies only, which biases the selection due to a tendency for only studies that have significant findings to be published, and therefore those that either fail to reject the null hypothesis or are inconclusive, despite being of equal methodological quality, being excluded (Easterbrook, Berlin, Gopalan & Matthews, 1991). This may provide an inflation of the success of the interventions studied and should be accounted for when interpreting the findings to the general pain population. In addition, although Cohen's d effect sizes were calculated in order to provide a measure of the magnitude of the strength of the differences between two groups (Dunst, Hamby & Trivette, 2004), unfortunately, these could not be calculated for all findings in all of the studies, due to a lack of availability of the necessary data. Although this may mean that some important findings were overlooked, this only occurred across a small proportion of the findings within five studies (See Table 1) (Klimes *et al.*, 1990; Kole-Snijders *et al.*, 1999; Morone *et al.*, 2009; Schmidt *et al.*, 2001; Thorn *et al.,* 2011).

Other limitations of this review exist due to the method of self-report questionnaires in order to gain outcome data. These measures are susceptible to reporter bias and therefore may not provide a true indication of the level of adjustment to pain. The use of self-report to also measure adherence to treatment regimens is also problematic and a desire to please the researcher may inflate the reported level of engagement. Furthermore, a number of the studies fail to provide long-term follow-up outcome data, which would help to establish the longevity of benefits derived from the treatments. It is also possible that increased practice and engagement with treatment strategies may actually be more effective in the long-term rather than immediately post treatment.

The importance of using an active treatment comparison group as well as a waiting list control group is essential in being able to determine the benefits derived solely from the therapeutic content. Furthermore, the majority of studies employ a group setting for treatment delivery, which may differ in effectiveness in comparison with individual therapy. Research however comparing individual and group approaches has demonstrated no significant differences between these methods (Turner-Stokes *et al.,* 2003).

Conclusion

In conclusion, although no definitive results have been obtained regarding the comparison in efficacy between cognitive and third wave interventions, results relating to the benefits of both treatment approaches have been promising. This review has been helpful in highlighting the methodological constraints that exist within the studies investigating interventions of this nature, and in particular has emphasised gaps in the research for ACT specifically within a chronic pain population. In general for all the approaches considered within this review, further research of a higher quality using the Yates criteria in the design of the study is required. In addition, studies making comparisons to an active treatment condition while maintaining sufficient power and include process measures for use in mediation analyses are also necessary to further evaluate these findings and to investigate the psychological processes that may contribute to treatment outcomes.

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4

The relationship between Cognitive and Acceptance Variables in Adjustment to Chronic Pain

Although the majority of studies included in the systematic review do not investigate the role of the specific process variables in predicting intervention outcomes, this has been examined elsewhere. To date, a substantial volume of research has been conducted to support the theoretical principles of both Cognitive Behavioural Therapy and Acceptance and Commitment Therapy. Cognitive components including, catastrophising, fear of movement, pain control beliefs and pain self-efficacy, have been shown to predict pain intensity, psychological distress including anxiety and depression, and pain related disability (Asghari & Nicholas, 2001; Crombez *et al.,* 1999; Hanley *et al.,* 2008; Osborne *et al.,* 2007; Turner *et al.,* 2002; Roelofs *et al.,* 2007 Sarda *et al.,* 2009). Furthermore, acceptance components including activity engagement, pain willingness, experiential avoidance and cognitive fusion have also demonstrated their capacity to predict physical disability, depression, anxiety and life satisfaction (McCracken *et al.,* 2005; McCracken & Eccleston, 2006; Vowles *et al.,* 2007; Vowles *et al.,* 2011; Vowles & McCracken, 2010; Wicksell, Lekander *et al.,* 2010).

Various studies assessing the effectiveness of ACT and CBT interventions for pain have demonstrated the association between these cognitive and acceptance components and treatment gains. This literature indicates a mediating role of cognitive and acceptance variables in the relationship between intervention and treatment outcomes (Burns, Glenn *et al.,* 2003; Burns Kubilus *et al.,* 2003; Jensen *et al.,* 2001; Jensen *et al.,* 2007; Smeets, Vlaeyen, Kester *et al.,* 2006; Turner *et al.,* 2007; Wicksell, Olsson *et al.,* 2010). Subsequently, as these studies reinforce a specific method for managing pain

based on the intervention being tested, it is expected to be more likely that the psychological processes involved will correspond. This therefore does not provide the best basis for comparison of the two separate psychological constructs or an understanding of the relationships between the two concepts within the context of pain adjustment in general.

Few studies have compared the predictive ability of acceptance and cognitive-based components in pain adjustment and for those that have made these comparisons, mixed findings have been reported. Two studies have shown psychological flexibility to be a superior predictor of depression, disability and life satisfaction compared to fear of movement pain beliefs (Wicksell, Lekander *et al.,* 2010; Wicksell, Olsson *et al*., 2010). Furthermore a study has highlighted that acceptance was a better predictor of physical functioning whereas catastrophising was a better predictor of anxiety and depression (Esteve *et al.,* 2007). In contrast however, other research comparing acceptance-based and cognitive components appear to have identified a trend towards acceptance variables being more predictive of emotional adjustment, whereas cognitive variables particularly self-efficacy to be superior in predicting physical disability (Nicholas & Asghari, 2006; Perry *et al.,* 2009; Sarda *et al.,* 2009; Viane *et al.,* 2003).

Research examining acceptance and cognitive variables and their relationships to pain severity, emotional well-being and physical disability, have highlighted their potential mediating and/or moderating role between pain and adjustment (both emotional and physical) (Arnstein *et al*; 1999; Arnstein *et al*., 2000; Barakat *et al.,* 2007; Elander *et al.,* 2009; Fish *et al.,* 2010; Gillanders *et al.,* Submitted; Kratz *et al.,* 2007; Miro *et al.,* 2011). This existing research emphasises the important role that both psychological processes have in influencing the impact that pain has on adjustment and ultimately in predicting the extent to which an individual is debilitated by their pain.

The potential mediating role of acceptance variables in the relationship between cognitive components and adjustment to pain has also been suggested in studies demonstrating acceptance as a mediator between variables including catastrophising and negative thoughts, and physical and psychological

functioning (Elander *et al.,* 2009; Vowles *et al.,* 2008). Such findings are correspondent with theory underlying acceptance-based approaches, which emphasises the importance of context rather than content. That is, the way in which one responds to an internal experience is more influential than the nature of specific thought or belief (Hayes, 2004). These preliminary findings suggest that the degree to which the presence of negative beliefs and thoughts affects one's ability to manage pain is dependent upon their level of psychological flexibility.

To date however there have been a lack of studies which evaluate several cognitive and acceptance variables simultaneously in their ability as mediators in the relationship between pain and adjustment. Fewer still have investigated the potential mediating role of acceptance between cognitive variables and adjustment to pain. Limitations due to the statistical methods utilised in some of the existing research have contributed to the absence of studies investigating the theoretically complex relationships between pain, and cognitive and acceptance variables that may assist in explaining adjustment to pain.

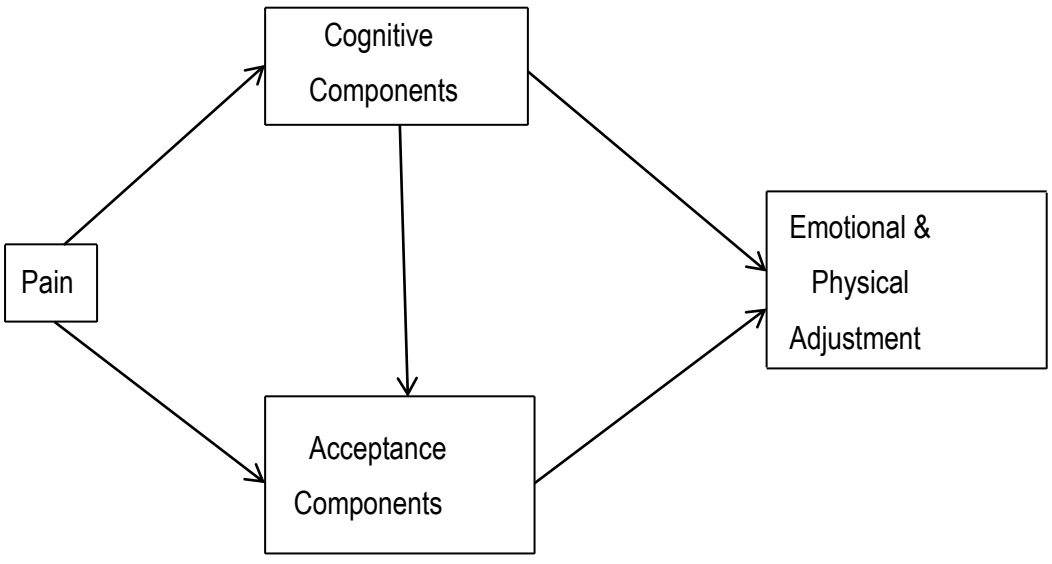
5

Research Aims and Hypotheses

The current research aims to extend the existing literature by investigating further the relationships between pain, acceptance and cognitive components, in their ability to predict adjustment to pain. The intentions of this study are: to be able to examine these variables collectively by testing a hypothesis driven model (see figure 1); to enable comparisons in their ability to predict pain adjustment to be made; and to test the complex relationships that have been proposed within the existing theory and literature. The research will test the following two hypotheses:

1. Cognitive and acceptance components mediate the relationship between pain and physical and emotional adjustment.
2. Acceptance components mediate the relationship between cognitive variables and emotional and physical adjustment to pain.

Figure 1: Hypothesised Model of Pain Adjustment



6

Methodology

6.1 Research Design

This study employed a cross-sectional survey-based design, adopting structural equation methods in order to test the hypothesised models. The study design was based on the completion of a series of self-report measures at a single time point. Independent variables included pain severity, fear of movement, self-efficacy and catastrophising, as well as psychological flexibility and acceptance. These were investigated in their ability to predict the outcome variables, pain disability, depression and anxiety.

6.2 Participants

6.2.1 Inclusion

In order to gain a population with a varying range of pain beliefs and levels of acceptance, patients with chronic pain (including headache) attending a multidisciplinary pain clinic or those who had attended within a year from the recruitment start date (February, 2011), were included. Patients also attending Pain Association Scotland pain management groups were approached by the lead researcher and given the option of participating. As recommended by the IASP (1986) chronic pain was defined as having occurred for over 3 months, which would be considered longer than the normal tissue healing time. Only patients aged 18 and over were included in this study.

6.2.2 Exclusion

The exclusion criteria included patients who were unable to provide informed consent and/or those with known substance misuse issues and/or severe psychiatric disorders that may compromise their ability

to provide informed consent. Patients who had other health conditions that had a significant impact upon their functional ability, aside from their pain, were also excluded. Information regarding exclusion factors was obtained via other members of the multi-disciplinary team prior to recruitment or was identified on completion of the demographics questionnaire.

6.2.3 Recruitment

Patients currently attending a pain clinic or voluntary sector pain support group within the health board or who had attended within a year from the start date (February, 2011), and who met the inclusion criteria were contacted in person by the principal researcher or by post. In total 550 questionnaires were posted, with 167 being returned, and of approximately 70 patients who were approached in clinic, 55 agreed to participate, yielding a total response rate of 35.8%. A distinct variation in response rate is evident between these different methods of recruitment, with participants being approached in clinic being more likely to agree to participate. The results of a series of t-tests and chi-square test for gender, however, indicate no significant differences on demographic variables or on scores across all measures between those recruited in clinic compared with those recruited by post (See appendix 1).

Eight participants were excluded due to being identified as having a further physical disability that was not associated with their pain. Three of these people had experienced stroke, three people had reported having a diagnosis of dementia (two reported Alzheimer's disease and one reported vascular dementia), and two patients were paraplegic. This left 214 patients who were included in the study. Patients who participated continued to receive care as usual, and there were no incentives to taking part in the research.

6.3 Procedure

6.3.1 Participant Invitation

Patients attending a Pain Management Clinic were approached by the lead researcher and asked if they would be interested in receiving information regarding the study. Where possible, a member of the multidisciplinary team was consulted by the lead researcher in order to ensure the study inclusion criteria were met. On agreement to receive further information, potential participants were informed that the research was to investigate the psychological components that predict adjustment to pain and that the results could be helpful in informing future strategies for pain management. The nature of potential participant involvement in the study was also provided and patients were informed that participation was purely voluntary and would have no implications regarding their treatment within the pain clinic. Participants were then issued with the study pack for their perusal, which included the Information sheet, consent form and questionnaire booklet with return envelope. Please see Appendix 2 for the information sheet, consent form and demographic questionnaire.

A similar procedure was undertaken for recruitment from the Pain Association. However, instead of being provided with a verbal account of the research individually, the lead researcher presented information regarding the nature of the research to the entire pain management group simultaneously. On demonstrating interest in the research, potential participants were then issued with the study pack.

Participants recruited by post were identified from an online patient database (TOPAS), which was utilised by the Pain Clinic in order to allocate appointments to patients. All members of the multi-disciplinary pain team, including the lead researcher, had access to this. Patient contact details were accessed and study packs were sent out to 550 patients who were currently attending the pain clinic and who had attended within the year prior to the recruitment commencing (i.e. those attending from February 2010).

6.3.2 Obtaining Informed Consent

After reading the information sheet, patients were able to approach the researcher with any queries whilst in the pain clinic or contact by the telephone number provided on the information sheet. Patients were then required to read and sign the consent form. Patients that were unable to provide informed consent, either by not having capacity to complete the questionnaire or being unwilling to complete, were not included in the study.

6.3.3 Participant Involvement

Participation in the study required the individual to complete the questionnaire pack, which included an initial demographics questionnaire and the 8 short standardised questionnaires. Participants were either able to complete these within the pain clinic or in their own time as a paper and pencil task, or alternatively they could contact the lead researcher and complete the questionnaires by telephone.

On completion of the questionnaires, participants could return these to the lead researcher in person whilst attending the pain clinic, or by posting these in the stamped addressed envelope provided. No patients opted to complete the questionnaires over the telephone.

6.3.4 Data Retrieval and Storage

Questionnaires and consent forms given to the lead researcher were transported to a safe NHS storage location within a locked briefcase. All returned questionnaires and consent forms were stored separately within a locked filing cabinet in an NHS location. Anonymous data from the questionnaires was transferred onto a computer database and saved on a password protected NHS computer and encrypted memory stick. Data was accessed only by the lead researcher and the academic supervisor who was emailed the data securely via NHS mail.

6.4 Ethical Considerations

Ethical Approval was sought from South East of Scotland Ethics, Committee 1, and as the project was deemed to be a 'patient opinion survey' no further ethical approval was required. The main potential ethical issues for consideration related to participant confidentiality and consent. Confidentiality issues were addressed by ensuring all questionnaires were anonymous. Any identifiable information was not entered into the database and was destroyed. Consent forms and questionnaires were stored separately in a locked filing cabinet to further maintain confidentiality.

To ensure all participants were consenting to taking part in this research those who were unable to provide informed consent were not considered for the research. Prior to taking part in the research all participants were either verbally instructed or informed via their invitation letter to read the information sheet and consent form. These provided information regarding the content and purpose of the research, what would be expected, the reason they had been invited to take part, and where to direct any queries. In addition to being issued with an information sheet, this information was also disseminated verbally to potential participants approached within the clinic. The voluntary nature of their participation and their ability to withdraw from the research at any time without this having any impact upon their care was also highlighted within the information sheet and verbally communicated where possible.

6.5 Measures

Participants completed a demographics questionnaire and eight subsequent standardised questionnaires associated with their pain and current mood. The demographics questionnaire considered age, employment status, socioeconomic status, education level, nature of pain, and other health issues. The outcome measures consisted of two standardised questionnaires: the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) and the Pain Disability Questionnaire (PDQ) (Anagnostis *et al.,* 2004). Other standardised questionnaires consisted of: The McGill Pain

Questionnaire – Short Form (MPQ-SF) (Melzack, 1987), the Pain Catastrophising Scale (PCS) (Sullivan *et al.,* 1995), The Tampa Scale of Kinesiophobia – Short Form (TSK – SF) (Miller *et al.,* 1991), the Pain Self Efficacy Questionnaire (PSEQ) (Nicholas, 1989), the Chronic Pain Acceptance Questionnaire (CPAQ) (McCracken *et al,* 2004), and the Psychological Inflexibility in Pain Scale (PIPS) (Wicksell *et al.,* 2008).

6.5.1 The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983)

The Hospital Anxiety and Depression Scale was developed by Zigmond and Snaith in 1983 to identify anxiety and depression disorders within a non-psychiatric hospital setting. It consists of 14 items including an anxiety subscale (7 items) and a depression subscale (7 items) and has been specifically designed to prevent interference from somatic disorders by omitting the physical items associated with anxiety and depression. This therefore makes it a suitable measure of anxiety and depression within a pain population. Each item is scored from 0 to 3 and a highest total score of 21 can be obtained for each subscale. Scores have been categorised into normal range (0-7), mild (8-10), moderate (11-15) and severe (16-21).

Research has demonstrated the HADS reliability and validity within samples of patients with physical illness (Herrmann, 1997). A recent review of 747 papers using the HADS, demonstrated Cronbach's alpha coefficients of over .60 in all studies, demonstrating sufficient internal consistency and medium to strong correlations were found for the HADS-A and HADS-D subscales when compared to other questionnaires measuring anxiety and depression, indicating good concurrent validity (Bjelland *et al.,* 2002). It should be noted that for the purposes of the current study, total HADS scores were used as a measure of emotional adjustment.

6.5.2 The Pain Disability Questionnaire (PDQ) (Anagnostis *et al.,* 2004)

The Pain Disability Questionnaire (PDQ) is a measure of functional status, designed to measure the impact of pain on functioning within a Chronic Disabling Musculoskeletal Disorder (CDMD) population

(Anagnostis *et al.,* 2004). The PDQ was developed by evaluating and collating items from a number of other questionnaires measuring pain-related dysfunction. In the development of the PDQ the authors consider the potential limitations of existing measures including: the Oswestry Low Back Pain Disability Questionnaire (Fairbank et al., 1980), The Roland Morris Disability Questionnaire (Roland & Morris, 1983), The Million Visual Analog Scale (Million *et al.,* 1982) and the SF-36 (Ware & Sherbourne, 1992). Efforts are therefore made to account for these weaknesses within the PDQ, whilst also providing a measure of CDMD that is not solely limited to back pain and recognising the importance of psychosocial factors in the development and maintenance of disability (Anagnostis *et al.,* 2004).

The PDQ is a 15-item scale comprising of two factors: a 9-item Functional Status Component and a 6-item Psychosocial Component. Each individual item is scored on a 0 to 10 scale yielding an overall total score for functional disability ranging from 0 to 150, a total Functional Status score ranging from 0 to 90 and a total Psychosocial score ranging from 0 to 60. The original investigation into the psychometric properties of the PDQ has demonstrated strong reliability, responsiveness and validity (Anagnostis *et al.,* 2004).

6.5.3. The McGill Pain Questionnaire – Short Form (MPQ-SF) (Melzack, 1987)

The McGill Pain Questionnaire full version was originally developed to measure the different aspects of the subjective pain experience, consisting of 78 words indicative of sensory, affective and evaluative components of pain and also including a 5 point pain intensity scale (Melzack, 1975). The short-form version was later derived in order to provide a measure of subjective pain that was quicker and easier to use particularly within clinical research (Melzack, 1987). The MPQ-SF contains 15 words, comprising 11 sensory and 4 affective, as well as one item measuring pain intensity and one visual analog scale (VAS). Each word is rated from 0 to 3 yielding an overall total Pain Rating Index range from 0 to 45, and single scores from 0 to 5 for Pain intensity and 0 to 10 on the VAS.

In comparison with the original MPQ, which has been found to have sufficient retest reliability and content validity (Burckhardt, 1984; Melzack, 1975; Papageorgiou & Badley, 1989), strong correlations were found to be present between this and the MPQ-SF (Melzack, 1987). Research considering the psychometric properties of the MPQ-SF has found it to demonstrate good internal consistency reliability (Burckhardt & Bjelle, 1994), content validity (McDonald & Weiskopf, 2001) and construct validity (Wright *et al.,* 2001) in the measurement of subjective pain experience. Furthermore the scale's responsiveness and sensitivity to change has also been documented (Melzack, 1987).

6.5.4. The Pain Catastrophising Scale (PCS) (Sullivan *et al.,* 1995)

The Pain Catastrophising Scale (PCS) is a 13-item scale measuring the degree to which an individual experiences thoughts of a catastrophic nature, with regard to their pain (Sullivan *et al.,* 1995). This scale was developed in order to overcome concerns raised regarding the reliability and validity of pre-existing scales measuring catastrophising, such as the Coping Strategies Questionnaire (CSQ) Catastrophising sub-scale (Sullivan & D'Eon, 1990), the Pain Related Self-Statements Scale (PRSS) (Flor *et al.,* 1993), and the Cognitive Coping Strategy Inventory (CCS) (Butler *et al.,* 1989).

Each item on the PCS is rated on a 5-point scale from 0 to 4, yielding an overall total score between 0 and 52, and comprising three individual subscales, rumination (total score ranges from 0 to 16), magnification (total score ranges from 0 to 12) and helplessness (total score ranges from 0 to 24). Investigations regarding the psychometric properties of the PCS have identified Cronbach alpha values of an acceptable level for the total PCS score and each of the subscales. Further investigation has demonstrated strong test re-test reliability and criterion related, concurrent and discriminant validity of the PCS (Osman *et al.,* 1997; Osman *et al.,* 2000; Sullivan *et al.,* 1995).

6.5.5. The Tampa Scale of Kinesiophobia – Short Form (TSK – SF) (Miller et al., 1991)

The Tampa Scale of Kinesiophobia (TSK) is a measure of pain-related fear, specifically fear of movement and re-injury is investigated using this scale (Miller *et al.,* 1991). The TSK is derived of 17

items, each rated on a four point scale from 1 to 4, with four items being inversely phrased. Although different studies employing factor analyses have revealed varying factor structures, consisting of two, three or four subscales (French *et al.,* 2007), the original development of a total score continues to be recommended as the most valid and reliable measure (Vlaeyen *et al.,* 1995). The total score on the TSK measure is within the range of 17 to 68, with higher scores indicating greater fear of movement and re-injury beliefs.

Previous studies examining the Dutch Version of the TSK have shown good internal consistency and test re-test reliability (Crombez *et al.,* 1999; Koho *et al.,* 2001; Swinkels-Meewisse *et al.,* 2003). More recently investigations into the psychometric properties of the English version of the TSK have demonstrated it's internal consistency and positive correlation with other measures associated with the fear-avoidance model of pain (French *et al.,* 2007).

6.5.6. The Pain Self-Efficacy Questionnaire (PSEQ) – (Nicholas 1989)

Unlike previous measures of self-efficacy within the pain population (Lorig *et al.,* 1989; Jensen *et al.,* 1991), the Pain Self-Efficacy Questionnaire (PSEQ) endeavours to take the respondents pain into account when measuring their self-efficacy beliefs (Nicholas, 1989). By also striving to ensure items represent activities in general terms, this increases the scales relevance to a range of individuals with chronic pain compared to other similar measures (Altmaier *et al.,* 1993). Each item within the PSEQ is scored on a range of 0 to 6, to demonstrate the level of confidence the individual has in being able to perform the activity described despite their pain. A total score of between 0 and 60 is generated, with higher scores indicating greater self-efficacy beliefs (Nicholas, 1989).

The PSEQ has been widely used in a variety of different clinical settings and countries (Nicholas *et al.,* 2007). Research investigating the psychometric properties of the PSEQ has demonstrated excellent internal consistency and high test-retest reliability (Asghari & Nicholas, 2001; Williams *et al.,* 1996). The PSEQ has also been found to be strongly correlated with other more activity specific self-efficacy

scales, further highlighting its validity, and was found to be a better predictor of perceived work ability in injured workers with chronic pain when compared to the Self-Efficacy Scale (SES) (Gibson & Strong, 1996), which does not allow for the presence of pain.

6.5.7. The Chronic Pain Acceptance Questionnaire (CPAQ) – (McCracken et al, 2004)

The Chronic Pain Acceptance Questionnaire is derived from the Acceptance and Action Questionnaire (AAQ) (Hayes *et al.,* 2004), a scale of emotional avoidance, and the original version of the CPAQ consisted of 24 items measuring chronic pain acceptance (Geiser, 1992). This was later shortened to 20 items, comprising two subscales, a 9-item pain willingness subscale, and 11-item activity avoidance subscale (McCracken *et al.,* 2004). Each item was scored on a 7 point scale from 0 to 6, generating an overall total chronic pain acceptance score between 0 and 120, a willingness subscale score from 0 to 54 and activity avoidance score from 0 to 66.

The CPAQ has been widely used within a range of settings and countries, supporting its utility as a measure of chronic pain acceptance (McCracken & Vowles, 2006). Research investigating the psychometric properties of the CPAQ has demonstrated very good to excellent internal consistency of the two factor scale (McCracken *et al.,* 2004). There had however been recent debate regarding the two factor construct of the CPAQ and the ability of the willingness subscale to predict overall acceptance of pain (Nicholas & Asghari, 2006). However it remains the most appropriate measure of pain acceptance available currently.

6.5.8. The Psychological Inflexibility in Pain Scale (PIPS) – (Wicksell, 2008)

The Psychological Inflexibility in Pain Scale (PIPS) was developed in order to create an instrument to measure aspects of psychological inflexibility, including avoidance and cognitive fusion (Wicksell *et al.,* 2008). The PIPS is a 16 item scale comprising two subscales, a 10-item avoidance scale and a 6-item cognitive fusion scale. Each item is rated on a seven point scale from 1 to 7, with an overall total psychological inflexibility score ranging from 16 to 112, an avoidance subscale score between 10 and

70 and a cognitive fusion score ranging from 6 to 42, with higher scores representing greater psychological inflexibility.

As this measure has been developed fairly recently, information on its psychometric properties is limited to only a few studies. Those studies have however demonstrated good internal consistency, and construct validity has also been supported given that the PIPS was highly correlated with the CPAQ and the TSK (Wicksell *et al.,* 2008; Wicksell, Lekander *et al.,* 2010). Research has also showed the ability of the PIPS to explain more variance in comparison to the TSK on pain, disability, life satisfaction and depression (Wicksell, Lekander *et al.,* 2010). Although further research is required to gain more evidence in support of the validity and reliability of the PIPS, research is promising and to date it is the only measure considering psychological inflexibility in relation to pain, including avoidance and cognitive fusion.

6.6. Statistical Analysis

6.6.1 Power Analysis

The complexities of calculating the minimum sample size required for sufficient power, >0.8 or >0.9, within Structural Equation Modeling have been discussed in the literature, however, with no single definitive and recommended method being achieved (Kim, 2005). This is due to power being largely dependent upon the goodness of fit criteria with the sample size required varying considerably upon the choice of goodness of fit index (Hu & Bentler, 1999; McCallum *et al.,* 1996; Sivo *et al.,* 2006). Furthermore, as it is recommended that several fit indices be considered in order to establish the adequacy of model fit (Garver & Mentzer, 1999), this leads to ambiguity when attempting to calculate sufficient sample size. The absence of a clear procedure for establishing sample size has therefore led to the majority of researchers adopting 'rules of thumb' recommendations in order to ensure sufficient power for the model being investigated.

For sufficient power based on the use of structural equation modeling (SEM) it has been recommended that 10 participants are necessary for every parameter estimated within the analysis (Schreiber *et al.,* 2006), however, a minimum 'critical sample size' of 200 has also been proposed (Garver & Mentzer, 1999; Hoelter, 1983). In the current study, by converging the acceptance and cognitive measures into latent variables this would result in 9 parameters being tested in the most complex model, when emotional and physical adjustment were included in the same model. In the event that latent variables were unable to be tested due to poor fit, separate path analyses to test emotional and physical adjustment separately, would comprise 17 parameters each. This would indicate a minimum of 170 participants in order to ensure sufficient power. However, given the proposed minimum 'critical sample size' for SEM, a necessary minimum sample size of 200 was required to test the study hypotheses.

6.6.2. Demographic Data

Data was entered into IBM SPSS Statistics Version 19 where descriptive and preliminary analyses were conducted. Participant characteristics and demographic variables were analysed in order to calculate mean overall scores and standard deviations of the sample on age, years of education and pain duration. For other demographic variables including; gender; socio-economic status; employment status; education level; nature of pain; pain medication and anti-depressant medication, each participant was categorised into different classifications for each. For socio-economic status each participant was given a deprivation category from 1 to 6 (1= most affluent area, 6 = most deprived) as derived from the Carstairs Deprivation Index (McLoone, 2001) and to ease interpretation in this study was then grouped into low (score of 5 or 6), medium (score of 3 or 4) and high status (score of 1 or 2).

Employment status was as indicated on the participant's demographic questionnaire and education level was categorised based on the level of qualifications obtained (ranging from no qualifications to postgraduate degree). Nature of pain was classified by the area of the body and diagnosis given. Pain medication was categorised in line with the analgesic pain ladder (World Health Organisation, 1996)

into standard (over the counter pain relief that does not require prescription), medium strength (prescribed pain medication including mild opioids) and strong (including strong opioids), and anti-depressants were classified as SSRIs, Tricyclics or both. Frequencies within the entire sample were calculated and presented in percentages.

6.6.3. Data Screening

6.6.3.1 Missing Data

Missing data analysis revealed that 1.48% of values were missing from the entire data set and a Little's MCAR significance level of >0.05 indicated that data was missing completely at random. The nature of missing data has been indicated as non-problematic meaning that the majority of procedures for managing missing data would produce very similar results (Tabachnick & Fidell, 2007, pp 62-63). Expectation Maximisation was used, which is an iterative procedure that uses Maximum Likelihood estimation to create estimates for the missing data and parameters, re-estimates the missing data based on these new estimates, and finally recalculates new parameters again based on both the actual and re-estimated missing data (Graham & Donaldson, 1993). Expectation Maximisation has been shown to be superior to alternative methods for managing missing data and was therefore used to impute missing values (Roth, 1994).

6.6.3.2 Distribution of Data

Tests of normality were conducted on SPSS in order to determine distribution of data prior to conducting parametric analyses (Gravetter & Wallnau, 2000, p.52). The Kolmogorov-Smirnov statistic, skewness and kurtosis statistics and z scores were examined. A non-significant Kolmogorov-Smirnov statistic is indicative of normal distribution (Pallant, 2002, p. 58) and a critical value of <3.29 for z-scores are suggestive of normality when sample sizes are large (Field, 2011, p.139). In samples over 200 participants, however, small deviations from normality can produce significant results and therefore less emphasis should be placed on the significance of these statistics and more on perusal of the

normal probability plots, residuals scatterplots and histograms for each of the measures (Field, 2011, p 138).

6.6.3.3 Data Characteristics

The mean scores and standard deviations for the sample on each measure were calculated as well as the internal consistency (Cronbach's Alpha) for each measure within this sample, in order to establish a sufficient level of reliability of above 0.7 (Kline, 1999), however 0.65 can be acceptable particularly when the number of items in the scale exceeds 12 (Cortina, 1993). Pearson correlations were also conducted in order to ensure that significant relationships existed (0.3 and above) between the variables prior to further analyses being conducted (Pallant, 2002, p. 120). To also ensure that the multicollinearity assumption had not been violated all correlations were inspected to ensure that they did not exceed 0.9 (Tabachnick & Fidell, 2007, p. 89), the Variance Inflation Factors (VIF) were also verified to ascertain a value of <10 for each relationship (Myers, 1990) and Tolerance was examined to verify that values of >0.1 were obtained (Field, 2011, p.224). T-tests were also conducted to establish whether there was a significant effect of gender on any of the measures.

6.6.4 Hypothesis Driven Analysis

Structural Equation Modeling (SEM) was employed in order to test the research hypotheses. This method of analysis has been suggested to be superior to alternative multivariate procedures, due to several of its characteristics, including: the confirmatory rather than exploratory nature of SEM, which allows the investigation of specific hypothesised models; the ability to assess and account for measurement error, by providing explicit estimates of the error variance parameters; and the ability to build complex models to test the relationships between measureable as well as unobservable latent variables (Byrne, 2008, pp. 3-17). EQS 6.2 Structural Equations Program was used in order to test the hypothesised models and investigate the relationships between the variables. Individual data sets depicting the variables in each model were created in SPSS 19 and exported into EQS 6.2.

6.6.4.1 Confirmatory Factor Analysis

In order to establish whether the independent variables could be grouped together to form latent variables, Confirmatory Factor Analysis was conducted initially within EQS 6.2. Confirmatory Factor Analysis (CFA) is appropriate to use when testing the validity of a hypothesised latent variable model that has been established a priori, via the existing literature (Schumaker & Lomax, 2010, pp. 163-164). In the current study this was used to test whether the raw data could be grouped into three latent variables: pain, comprising the individual items of the MPQ; Acceptance, consisting of the individual items of both the CPAQ and the PIPS; and Cognitive, including the individual raw data derived from the TSK, PCS and PSEQ.

This model was run several times, in order to remove items from each of the measures which had weak loadings on the hypothesised latent factor with the purpose of improving the overall model fit. In order to assess the fit of the model, it is recommended that Chi-square and the associated degrees of freedom, the non-normed fit index (NNFI), the comparative fit index (CFI) and the root mean squared approximation of error (RMSEA) are reported (Garver & Mentzer, 1999). The NNFI and RMSEA should be interpreted with caution, however, as both rely on very large sample sizes and can underestimate the fit of a model in samples of less than 500 (Anderson & Gerbing, 1984; Hu & Bentler, 1999). Although all three indexes were reported, the CFI is likely to provide a more accurate account of model fit in the current study.

In order for a model to achieve a good fit firstly the Chi-square value should be low indicating non-significance, which highlights that there is no significant difference between the actual and predicted model inputs (Hoe, 2008). A value of >0.90 or >0.95 preferably for the NNFI or CFI (Bentler, 1990; Bentler & Bonnett, 1980; Hu & Bentler, 1999) indicate a good fit, or a value of <0.08 or <0.06 preferably for RMSEA is suggestive of an acceptable fit (Hu & Bentler, 1999; Steiger, 1990). One or more of these fit indexes being acceptable would indicate a sufficient fit for the model. Items that had low

standardised coefficients (<0.3) (Cohen, 1988) as observed from the Standardized Solution table in the EQS output, which indicated weak factor loadings, were omitted from the model and the analysis was re-run with the aim of improving the model fit.

6.6.4.2 Path Analyses Using Structural Equation Modeling

On establishing poor fit for the 3 factor latent variable model, two simple path analysis models were conducted with each of the cognitive and acceptance variables independently, in order to test their ability to mediate the relationship between pain and physical adjustment, and pain and emotional adjustment. Path analysis is a technique within structural equation modeling that tests theoretical relationships between measured variables (Schumaker & Lomax, 2010, pp. 143-144). It has a number of advantages in comparison with other types of regression analyses, including flexibility and few limitations with regard to the types of relationships that can be specified. Furthermore, it determines parameter estimates simultaneously from a number of equations, allowing variables to have both independent and dependent properties (to test for mediators), whilst also accounting for error, providing a goodness of fit for a hypothesised model, and presenting the results in a coherent diagrammatic model format (Schumaker & Lomax, 2010, pp. 143-144).

Following the administering of each path analysis the fit of the model was assessed by considering the Chi-square value and degrees of freedom, the NNFI, the CFI and the RMSEA values. As recommended in the literature, failure to achieve an adequate fit resulted in identifying, from the EQS output, the non-significant parameters ($p<0.05$) within the model and their subsequent removal (Byrne, 2008, p103; Schumaker & Lomax, 2010, pp. 64-67). Once non-significant pathways had been omitted and the path analysis was re-run and fit indices were again inspected. In the instance of a further poor fitting model, weak pathways were omitted ($r<0.3$) and variables that did not predict the hypothesised dependent variable (namely those that did not appear to have a role in pain adjustment) were also removed and the model was re-run. Furthermore, in order to arrive at the best fitting model, Lagrange Multiplier Test (LM Test) results, which highlight pathways in the model which could be added to

increase the overall fit, were consulted. Where the results of the LM Test made sense theoretically, pathways could be added between variables as indicated (Bentler, 2004).

For the final models, the standardised coefficient for each parameter was observed as well as the variance (R squared) accounted for by each independent variable in predicting each dependent. Subsequently, these procedures were then repeated for two double mediation path analyses models (or nested models) in order to also test the mediating role of acceptance variables in the relationship between cognitive variables and physical and emotional adjustment to pain. Similarly parameters that were non-significant were removed from the path model and subsequently weak pathways and variables that did not predict dependent variables were omitted in order to re-run the model. Similarly for the final nested models, standardised coefficients as well as R squared values were considered in order to interpret relationships between the each of the variables in predicting pain adjustment (Byrne, 2008, pp. 103-113).

7

Journal Article: Main Thesis Research

The Role of Cognitive and Acceptance Components in Predicting Functional and Emotional Adjustment to Chronic Pain

Prepared for Submission to the 'European Journal of Pain'

The Role of Cognitive and Acceptance Components in Predicting Functional and Emotional Adjustment to Chronic Pain

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Abstract

Background

The existing literature investigating the role of cognitive (pain related thoughts/beliefs) and acceptance components (pain willingness, activity engagement and psychological flexibility) in adjusting to chronic pain is in the preliminary stages. This research aims to extend the current findings by investigating the relationships between several cognitive and acceptance components in their ability to predict emotional and physical adjustment in the context of chronic pain.

Methods

The study employed a cross-sectional survey-based design, including 214 chronic pain patients recruited from an NHS pain clinic and voluntary sector support group. Participants completed a series of self-report questionnaires measuring several cognitive and acceptance components, pain severity, physical disability, and depression and anxiety. Structural Equation Modeling was used in order to conduct path analyses, investigating the complex relationships between these variables in predicting physical and emotional adjustment.

[2] Although the other three authors are credited on this paper due to the supervision they have provided, the writing is the work of the first author/principal researcher.

Results

Path analyses showed that pain self-efficacy was the only variable to have a strong mediating influence between pain and physical adjustment. Findings also demonstrated the importance of acceptance, catastrophising and self-efficacy as mediators between pain and emotional adjustment. In this model, acceptance was also found to mediate the relationship between pain catastrophising and emotional adjustment and partially for pain self-efficacy.

Conclusions

The importance of pain self-efficacy specifically in predicting physical adjustment to pain is highlighted. A more complex model however is required to explain emotional adjustment, with acceptance playing a more prominent role in comparison with other variables. Further research employing similar statistical methods are required to provide further support for these findings.

To date, a substantial volume of research has been conducted to support the theoretical principles of both Cognitive Behavioural Therapy and Acceptance and Commitment Therapy. Cognitive components including, catastrophising, fear of movement, pain control beliefs and pain self-efficacy, have been shown to predict pain intensity, psychological distress including anxiety and depression, and pain related disability (Asghari & Nicholas, 2001; Crombez *et al.,* 1999; Hanley *et al.,* 2008; Osborne *et al.,* 2007; Roelofs *et al.,* 2007; Sarda *et al.,* 2009; Turner *et al.,* 2002). Furthermore, acceptance components including activity engagement, pain willingness, avoidance and cognitive fusion have also demonstrated their capacity to predict physical disability, depression, anxiety and life satisfaction (McCracken *et al.,* 2005; McCracken & Eccleston, 2006; Vowles *et al.,* 2007; Vowles *et al.,* 2011; Vowles & McCracken, 2010; Wicksell, Lekander *et al.,* 2010).

Research examining acceptance and cognitive variables and their relationships to pain severity, emotional well-being and physical disability, have highlighted their potential mediating and/or moderating role between pain and adjustment (Arnstein *et al*; 1999; Arnstein *et al*., 2000; Barakat *et al.,*

2007; Elander *et al.,* 2009; Fish *et al.,* 2010; Gillanders *et al.,* Submitted; Kratz *et al.,* 2007; Miro *et al.,* 2011). This existing research emphasises the important role that both psychological processes have in influencing the impact that pain has on adjustment and ultimately in predicting the extent to which an individual is debilitated by their pain.

The potential mediating role of acceptance variables in the relationship between cognitive components and adjustment to pain has also been suggested in studies demonstrating acceptance as a mediator between variables including catastrophising and negative thoughts, and physical and psychological functioning (Elander *et al.,* 2009; Vowles *et al.,* 2008). Such findings are correspondent with theory underlying acceptance-based approaches, which emphasises the importance of context rather than content. That is, the way in which one responds to an internal experience is more influential than the nature of specific thought or belief (Hayes, 2004). These preliminary findings suggest that the degree to which the presence of negative beliefs and thoughts affects one's ability to manage pain is dependent upon their level of psychological flexibility.

To date however there have been a lack of studies evaluating the theoretically complex relationships between pain, and cognitive and acceptance variables in explaining adjustment to pain. Constraints due to the statistical methods utilised in some studies have contributed to the absence of research evaluating several cognitive and acceptance variables simultaneously in their ability as mediators in the relationship between pain and adjustment. The current research aims to extend the existing literature by examining these variables collectively in order to make comparisons in their ability to predict pain adjustment and to test the complex relationships that have been proposed within the existing theory and literature. It is hypothesised that cognitive and acceptance components will mediate the relationship between pain and pain adjustment (including physical and emotional adjustment), and secondly that acceptance components will mediate the relationship between cognitive variables and both physical and emotional adjustment to pain.

Methods

Design

This study employed a cross-sectional survey-based design aimed at patients attending a National Health Service multi-disciplinary pain service and/or voluntary sector patient support organisation. The study design was based on the completion of a series of self-report measures at a single time point, which assessed independent predictors of pain adjustment including; pain severity, fear of movement, self-efficacy and catastrophising, as well as psychological flexibility and acceptance, and dependent variables comprising pain disability, depression and anxiety. Hypothesised theory driven models were analysed from the data using structural equation modeling using EQS 6.2 (Bentler, 2004).

Inclusion/Exclusion Criteria

Patients who meet the IASP (1986) criteria for chronic pain (pain of 3 months duration or more) attending a multidisciplinary pain clinic or voluntary sector pain management support groups were eligible for recruitment. Participants had to be aged 18 years or over and were excluded if they were unable to provide informed consent or had known substance misuse issues or severe psychiatric disorders that may also compromise informed consent. Patients who had other health conditions that may have had a significant impact upon their functional ability, aside from their pain, were also excluded. Information regarding exclusion factors was obtained via other members of the multi-disciplinary team prior to recruitment or was identified on completion of the demographics questionnaire.

Participants and Procedure

Patients attending a multi-disciplinary Pain Management Clinic or a voluntary sector Pain Management support group were either approached by the lead researcher or sent information by post to inform

them of the study. All potential participants were issued with an information sheet, consent form, questionnaire booklet and stamped addressed return envelope. Of the 550 questionnaires posted, 167 were returned and of the 70 participants approached in clinic, 55 agreed to participate, yielding a total response rate of 35.8%. Eight participants were excluded (3 had a recent stroke, two had a diagnosis of Alzheimer's disease and one had Vascular dementia, and two were paraplegic), giving a total of 214 participants included in the study.

Of these 57.9% of participants were female, and the mean age of the sample was 51.23 (SD 12.34) years. The majority of participants (51.9%) were within the medium range for socio-economic status and were also unemployed (43.4%), with 36.4% of the sample being unable to work due to their pain. The mean duration for pain was 9.6 (SD 9.57) years. The most common type of pain was back pain (32.2%). However, a large proportion (14%) of the sample did experience pain in more than one body site or had a diagnosis of more than one disorder associated with their pain (8.4%). A high proportion of the sample (64%), were prescribed what was considered 'medium strength' pain medication (World Health Organisation, 1996).

Measures

Participants completed a demographics questionnaire and eight standardised questionnaires measuring their pain, current mood, disability and psychological components. The demographics questionnaire considered age, employment status, socioeconomic status, education level, nature of pain, and other health issues.

The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983)

The HADS consists of 14 items including an anxiety subscale (7 items) and a depression subscale (7 items) and has been specifically designed to prevent interference from somatic disorders by omitting the physical items associated with anxiety and depression. This therefore makes it a suitable measure of anxiety and depression within a pain population. Each item is scored from 0 to 3 and a highest total

score of 21 can be obtained for each subscale. Scores have been categorised into normal range (0-7), mild (8-10), moderate (11-15) and severe (16-21). The psychometric properties of this measure have been widely assessed and it has been demonstrated to have good reliability and validity (Bjelland et al., 2002; Herrmann, 1997). It should be noted that for the present study, total HADS scores have been used as a measure of emotional adjustment.

The Pain Disability Questionnaire (PDQ) (Anagnostis *et al.,* 2004)

The PDQ is a 15-item scale comprising two factors: a 9-item Functional Status Component and a 6-item Psychosocial Component. Each individual item is scored on a 0 to 10 scale yielding an overall total score for functional disability ranging from 0 to 150, a total Functional Status score ranging from 0 to 90 and a total Psychosocial score ranging from 0 to 60. The original investigation into the psychometric properties of the PDQ has demonstrated strong reliability, responsiveness and validity (Anagnostis *et al.,* 2004).

The McGill Pain Questionnaire – Short Form (MPQ-SF) (Melzack, 1987)

The MPQ-SF contains 15 words, comprising 11 sensory and 4 affective, as well as one item measuring pain intensity and one visual analog scale (VAS). Each word is rated from 0 to 3 yielding an overall total Pain Rating Index range from 0 to 45, and single scores from 0 to 5 for Pain intensity and 0 to 10 on the VAS. Research considering the psychometric properties of the MPQ-SF has found it to demonstrate good internal consistency reliability (Burckhardt & Bjelle, 1994), content validity (McDonald & Weiskopf, 2001) and construct validity (Wright *et al.,* 2001) in the measurement of subjective pain experience. Furthermore the scale's responsiveness and sensitivity to change has also been documented (Melzack, 1987).

The Pain Catastrophising Scale (PCS) (Sullivan *et al.,* 1995)

The Pain Catastrophising Scale (PCS) is a 13-item scale measuring the degree to which an individual experiences thoughts of a catastrophic nature, with regard to their pain (Sullivan *et al.,* 1995). Each

item on the PCS is rated on a 5-point scale from 0 to 4, yielding an overall total score between 0 and 52, and comprising three individual subscales, rumination (total score ranges from 0 to 16), magnification (total score ranges from 0 to 12) and helplessness (total score ranges from 0 to 24). Investigations regarding the psychometric properties of the PCS have identified Cronbach alpha values of an acceptable level for the total PCS score and each of the subscales. Further investigation has demonstrated strong test re-test reliability and criterion related, concurrent and discriminant validity of the PCS (Osman *et al.,* 1997; Osman *et al.,* 2000; Sullivan *et al.,* 1995).

The Tampa Scale of Kinesiophobia – Short Form (TSK – SF) (Miller *et al.,* 1991)

The Tampa Scale of Kinesiophobia (TSK) is a measure of pain-related fear, specifically fear of movement and re-injury is investigated using this scale (Miller *et al.,* 1991). The TSK is derived from 17 items, each rated on a four point scale from 1 to 4, with four items being inversely phrased. The total score on the TSK measure is within the range of 17 to 68, with higher scores indicating greater fear of movement and re-injury beliefs. Previous studies examining the Dutch Version of the TSK have shown good internal consistency and test re-test reliability (Crombez *et al.,* 1999; Koho *et al.,* 2001; Swinkels-Meewisse *et al.,* 2003). More recently investigations into the psychometric properties of the English version of the TSK have demonstrated its internal consistency and positive correlation with other measures associated with the fear-avoidance model of pain (French *et al.,* 2007).

The Pain Self-Efficacy Questionnaire (PSEQ) – (Nicholas 1989)

Each item within the PSEQ is scored on a range of 0 to 6, to demonstrate the level of confidence the individual has in being able to perform the activity described despite their pain. A total score of between 0 and 60 is generated, with higher scores indicating greater self-efficacy beliefs (Nicholas, 1989). Research investigating the psychometric properties of the PSEQ has demonstrated excellent internal consistency and high test-retest reliability (Asghari & Nicholas, 2001; Williams *et al.,* 1996). The PSEQ has also been found to be strongly correlated with other more activity specific self-efficacy scales, further highlighting its validity, and was found to be a better predictor of perceived work ability in

injured workers with chronic pain when compared to the Self-Efficacy Scale (SES) (Gibson & Strong, 1996), which does not allow for the presence of pain.

The Chronic Pain Acceptance Questionnaire (CPAQ) – (McCracken *et al,* 2004)

This was later shortened to 20 items, comprising two subscales, a 9-item pain willingness subscale, and 11-item activity avoidance subscale (McCracken *et al.,* 2004). Each item was scored on a 7 point scale from 0 to 6, generating an overall total chronic pain acceptance score between 0 and 120, a willingness subscale score from 0 to 54 and activity avoidance score from 0 to 66. Research investigating the psychometric properties of the CPAQ has demonstrated very good to excellent internal consistency of the two factor scale (McCracken *et al.,* 2004). There had however been recent debate regarding the two factor construct of the CPAQ and the ability of the willingness subscale to predict overall acceptance of pain (Nicholas & Asghari, 2006). However it remains the most appropriate measure of pain acceptance available currently.

The Psychological Inflexibility in Pain Scale (PIPS) – (Wicksell, 2008)

The Psychological Inflexibility in Pain Scale (PIPS) was developed in order to create an instrument to measure aspects of psychological inflexibility, including avoidance and cognitive fusion (Wicksell *et al.,* 2008). The PIPS is a 16 item scale comprising two subscales, a 10-item avoidance scale and a 6-item cognitive fusion scale. Each item is rated on a seven point scale from 1 to 7, with an overall total psychological inflexibility score ranging from 16 to 112, an avoidance subscale score between 10 and 70 and a cognitive fusion score ranging from 6 to 42, with higher scores representing greater psychological inflexibility. As this measure has been developed fairly recently, information on its psychometric properties is limited to only a few studies. Those studies have however demonstrated good internal consistency, and construct validity has also been supported given that the PIPS was highly correlated with the CPAQ and the TSK (Wicksell *et al.,* 2008; Wicksell, Lekander *et al.,* 2010).

Statistical Analysis

Missing data analysis revealed that 1.48% of values were missing completely at random and expectation maximisation was therefore used to impute this missing data. Observations of the normality plots, residuals scatterplots and histograms were conducted as well as statistical tests (Kolmogorov-Smirnov and Z-score calculations) revealing negative skewness for the PDQ and PCS, and positive skewness for the PSEQ (Tabachnick & Fidell, 2006, p. 80). Preliminary analyses conducted in SPSS19 included the calculation of the mean scores and standard deviations for the sample on each measure as well as the internal consistency (Cronbach's Alpha) for each measure. Pearson correlations were performed to assess the relationships between variables and to ensure that the multicollinearity assumption had not been violated and a post hoc bonferroni adjustment was conducted to reduce the occurrence of Type 1 error.

Structural Equation Modeling (SEM) was employed using EQS 6.2 to analyse relationships between the variables. Confirmatory Factor Analysis (CFA) was conducted initially in order to test whether pain, cognitions and acceptance could be grouped together as three separate latent variables. Items from each of the measures that demonstrated weak loadings (standardised coefficients of <0.3) were removed and the model was re-run to establish goodness of fit. On determining a poor fit for the 3 factor CFA model, two separate SEM path analyses were conducted (one for emotional adjustment and one for physical adjustment), applying robust statistical methods to account for non-normally distributed data, to test the hypotheses relationships between the variables in their ability to predict adjustment to pain.

Results

The means, standard deviations and Cronbach's alpha value for the MPQ-SF, PDQ, HADS, TSK, PCS, CPAQ and the PIPS and their corresponding subscales are presented in Table 1, as are the Pearson correlation values between each of the measures.

Table 1 Means (M), Standard deviations (SD), internal consistency (α) and intercorrelations of all measures

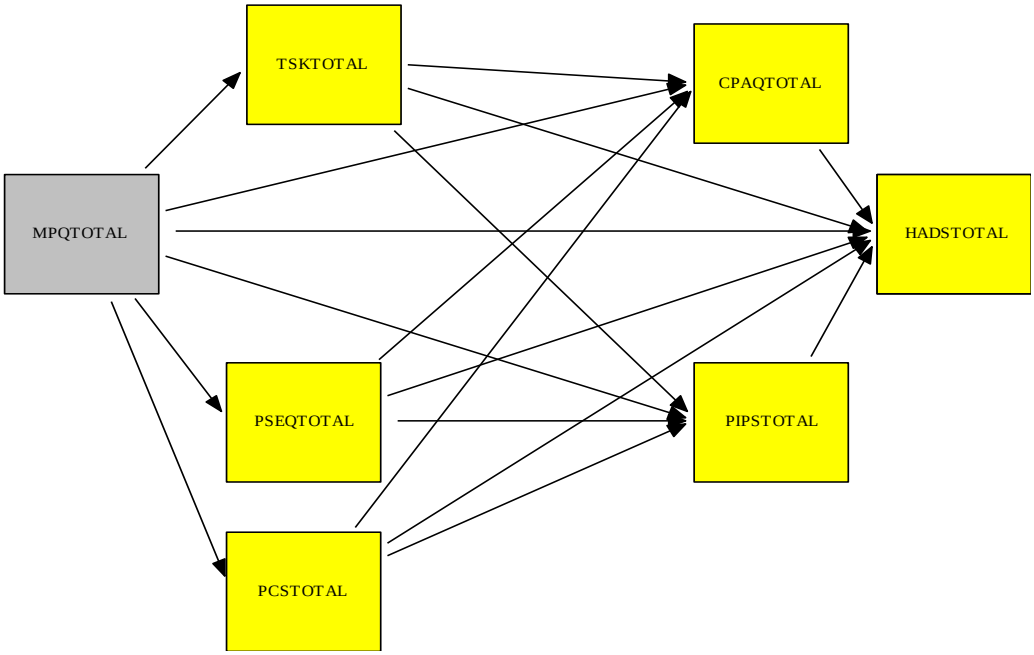
	Measure	M (SD)	α	2	3	4	5	6	7	8	9
1	MPQ Total	25.12 (10.03)	0.854	0.421**	0.358**	0.486**	0.283**	-0.380**	-0.366**	0.380**	0.341**
	Sensory	18.90 (7.23)	0.789								
	Affective	6.21 (3.69)	0.775								
2	PDQ Total	89.86 (31.93)	0.937		0.763**	0.602**	0.537**	-0.817**	-0.723**	0.474**	0.631**
	Function	53.13 (20.3)	0.930								
	Psychosoc	36.73 (13.72)	0.843								
3	Depression	9.78 (5.19)	0.879			0.746**	0.494**	-0.749**	-0.756**	0.527**	0.622**
4	Anxiety	10.8 (5.21)	0.875				0.429**	-0.612**	-0.668**	0.592**	0.597**
5	TSK Total	42.35 (9.34)	0.865					-0.501**	-0.618**	0.466**	0.582**
6	PSEQ Total	26.64 (15.80)	0.951						0.811**	-0.532**	-0.701**
7	CPAQ Total	52.92 (21.19)	0.884							-0.672**	-0.819**
	AE	32.53 (15.26)	0.903								
	PW	20.39 (9.99)	0.785								
8	PCS Total	30.46 (14.13)	0.947								0.717**
	Rumination	10.37 (4.91)	0.916								
	Magnification	5.81 (3.55)	0.768								
	Helplessness	14.28 (6.86)	0.908								
9	PIPS Total	78.45 (20.45)	0.920								
	Avoidance	45.62 (15.85	0.935								
	Cog Fusion	32.83 (6.35)	0.678								

**p<0.0001 (two-tailed), AE = Activity Engagement, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, PW = Pain Willingness, TSK = Tampa Scale for Kinesiophobia.

The results from the CFA 3 factor model demonstrated an unacceptable fit (Chi-square = 8561.978, df = 3077, CFI = 0.551, NNFI = 0.539, RMSEA = 0.091), even when individual items that had weak loadings (5, 8, 12, 13, 16 of the TSK, items 4, 7, 11 and 16 from the CPAQ and items 4 and 5 from the PIPS) were removed. This indicates that the data does not suitably assimilate into either pain, cognitive or acceptance factors and this model was inappropriate to use in assessing the study hypotheses.

Figure 1 illustrates the hypothesised double mediation model for emotional adjustment to pain. This tests the hypothesis that cognitive and acceptance variables have a mediating role in the relationship between pain and emotional adjustment, and that acceptance components are also mediators of the relationship between cognitive components and emotional adjustment. The results identified non-significant pathways between the MPQ and the CPAQ, the MPQ and the PIPS, the TSK and the HADS, and the PIPS and the HADS. Removal of these path ways, however, did not provide an adequate fit

Figure 1: Hypothesised Model: Emotional Adjustment to Pain

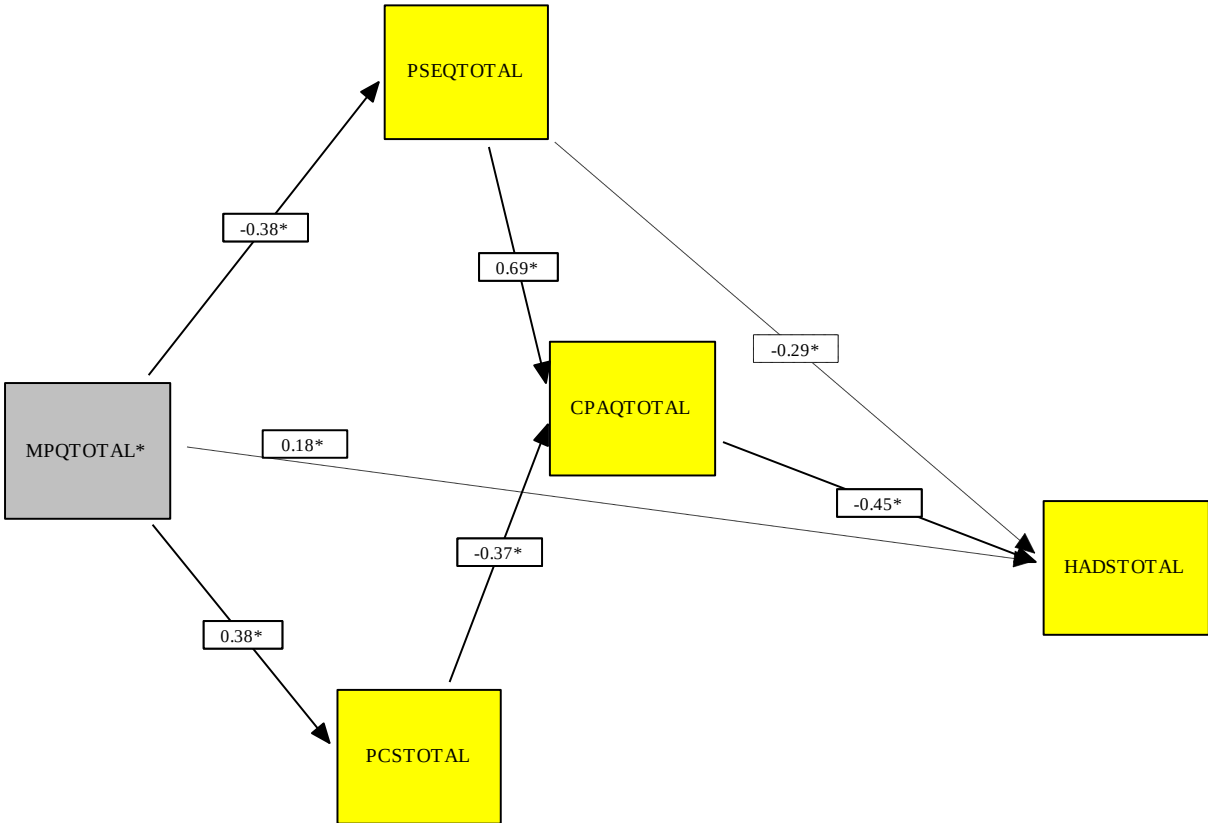


HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

when the model was re-run (Chi-Square = 146.228, df = 8, NNFI = 0.699, CFI = 0.885, RMSEA = 0.258).

The next step was to re-run the model eliminating weak pathways (standardised coefficients of <0.30) and components that did not predict any of the dependent variables in the model. Removal of pathways between the MPQ and TSK, the MPQ and the HADS, the TSK and CPAQ, the TSK and PIPS, and the PCS and the HADS and also ommitting the TSK and PIPS due to their poor ability to predict any of the dependent variables revealed an adequate fit for the final model due to the CFI index being at an acceptable level (Chi-Square = 68.619, df = 4, NNFI = 0.769, CFI = 0.908, RMSEA = 0.265). When considering the Lagrange Multiplier Test to establish whether the addition of any pathways would increase the model fit, this resulted in the

Figure 2: Emotional Adjustment Path Analysis



_____ confirmed pathways β>0.3, ---------- weak pathways β<0.3, *p<0.05

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale.

addition of the pathway from the MPQ to the HADS into the model, which improved the model fit marginally (Chi-Square = 52.441, df = 3, NNFI = 0.745, CFI = 0.924, RMSEA = 0.278).

The final model is presented in figure 2 with the corresponding standardised path coefficients. The model indicates that within the relationship between pain and emotional adjustment, acceptance is a mediator between catastrophising and emotional adjustment and a partial mediator in the relationship between self-efficacy and emotional adjustment. From the standardised path coefficients it can be

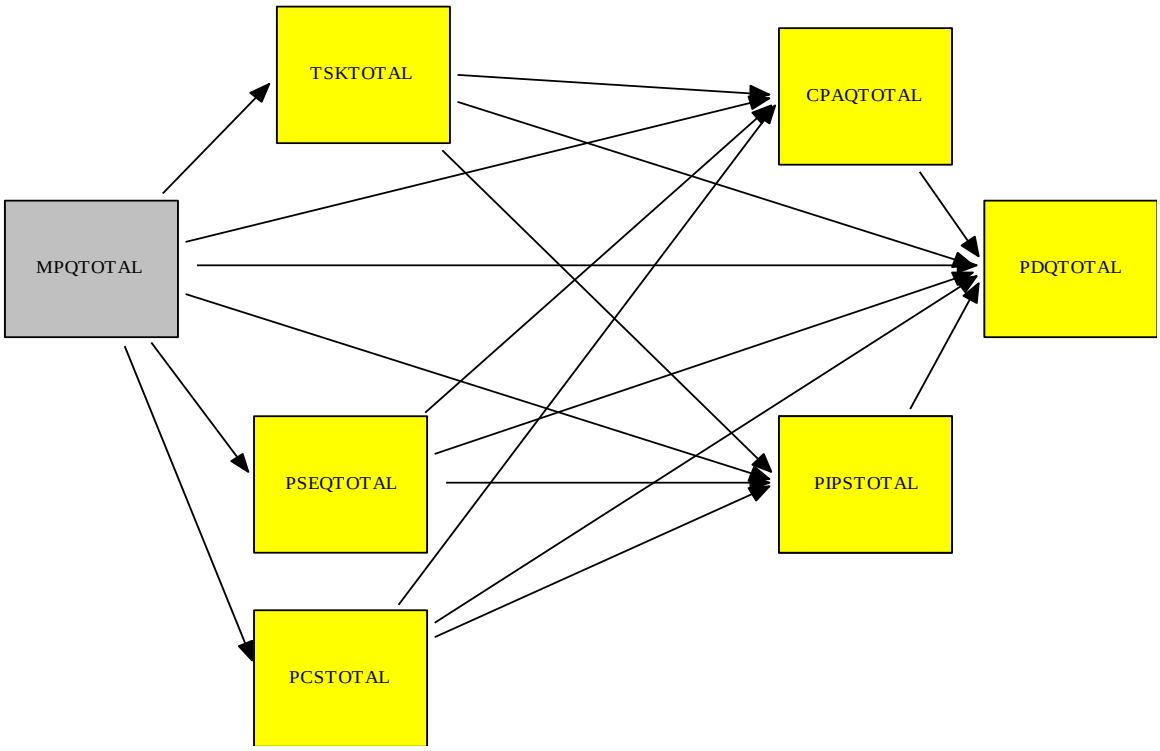
inferred that acceptance has a stronger relationship with emotional adjustment (β = -0.45) than self-efficacy (β = -0.29), providing a more prominent role in the overall variance accounted for by the model.

Table 2: Path Coefficients, Error and Variance Explained for Emotional Adjustment Path Analysis

Path	Standardised Coefficient (β)	Significance (p)	Error	Variance (R-Squared)
MPQ – PSEQ	-0.380	<0.05	0.925	0.144
MPQ – PCS	0.380	<0.05	0.925	0.144
PSEQ – CPAQ	0.693	<0.05	0.559	0.687
PCS – CPAQ	0.367	<0.05		
CPAQ – HADS	-0.446	<0.05	0.621	0.614
PSEQ – HADS	0.291	<0.05		
MPQ – HADS	0.179			

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety and Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

Figure 3: Hypothesised Model: Physical Adjustment to Pain

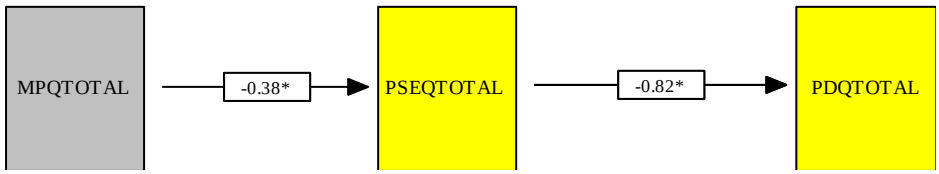


CPAQ=Chronic Pain Acceptance Questionnaire, MPQ=McGill Pain Questionnaire, PCS=Pain Catastrophising Scale, PDQ= Pain Disability Questionnaire, PIPS=Psychological Inflexibility in Pain Scale, PSEQ=Pain Self-Efficacy Questionnaire.

Table 2 shows the standardised path coefficients (β), the statistical significance, the associated error and the proportion of variance (R-Squared) accounted for each of the dependent variables by the predictor independent variables within the model. The results indicate that a substantial amount, 61%, of variance (R-squared = 0.614) was accounted for by pain, catastrophising, self-efficacy and acceptance in predicting emotional adjustment.

The hypothesis that cognitive and acceptance variables have a mediating role in the relationship between pain and physical adjustment, and that acceptance components are also mediators of the relationship between cognitive components and physical adjustment is presented in figure 3. The same procedure was performed as before. A number of non-significant pathways were identified, including the relationships between the MPQ and CPAQ, the MPQ and PIPS, the PCS and PDQ, the CPAQ and PDQ, the PIPS and PDQ. The results showed that the model, with all of the cognitive and acceptance variables included almost acheives an adequate goodness of fit (Chi-Square = 148.003, df = 9, NNFI = 0.744, CFI = 0.890, RMSEA = 0.240).

Figure 4: Physical Adjustment Path Analysis



_____ confirmed pathways, *p<0.05

MPQ = McGill Pain Questionnaire, PDQ = Pain Disability Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

Further trimming of the model in terms of elimination of further weak pathways, including the relationships between the MPQ and TSK, the TSK and CPAQ, the TSK and PIPS, and the TSK and PDQ, and the variables that were poor predictors of the dependent variables (comprising the TSK,

PCS, CPAQ and PIPS) was conducted. Figure 4 presents the final model, which provides the best fit for the variables (Chi-square = 9.324, df = 1, NNFI = 0.909, CFI = 0.970, RMSEA = 0.198). This linear model represents the mediating ability of self-efficacy in the relationship between pain severity and physical adjustment.

Table 3: Path Coefficients, Error and Variance Explained for Physical Adjustment Path Analysis

Path	Standardised Coefficient (β)	Significance (p)	Error	Variance (R-Squared)
MPQ – PSEQ	-0.380	<0.05	0.925	0.144
PSEQ – PDQ	-0.817	<0.05	0.576	0.668

MPQ = McGill Pain Questionnaire, PDQ = Pain Disability Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

The results show that acceptance does not have a mediating role for physical adjustment in the relationship between this and self-effcacy, and highlights that self-efficacy is the only process variable to make a substantial contribution to physical adjustment when the other variables are accounted for. Table 3 shows the standardised path coefficients (β), the associated error and the proportion of variance (R-Squared) accounted for each of the dependent variables by the predictor independent variables within the model. The results indicate that a substantial, 67%, amount of the variance (R-squared = 0.668) was accounted for by pain and self-efficacy in predicting physical adjustment.

Discussion

The hypothesis that cognitive and acceptance components mediate the relationship between pain and physical and emotional adjustment is supported for physical adjustment to pain as well as emotional adjustment. For physical adjustment to pain, however, it was demonstrated that when all cognitive and acceptance variables were considered simultaneously, it was only pain self-efficacy that had a significant and strong mediating influence in the relationship between pain severity and physical adjustment. This is supported by other studies (Arnstein *et al.,* 1999; Arnstein *et al.,* 2000; Asghari &

Nicholas, 2001; Miro *et al.,* 2011; Nicholas & Asghari, 2006; Sarda *et al.,* 2009) and indicates that irrespective of the severity of pain one is experiencing, the more confident the person is to manage their pain and to engage in activity, the less likely the pain experience will interfere with daily living.

For emotional adjustment it was apparent that acceptance, pain self-efficacy and catastrophising had a role in mediating the relationship between pain severity and emotional adjustment. These findings are consistent with existing research which demonstrates that acceptance is a better predictor of emotional adjustment including depression and anxiety, whereas physical adjustment is best predicted by self-efficacy (Nicholas & Asghari, 2006; Perry *et al.,* 2009; Sarda *et al.,* 2009; Viane *et al.*, 2003).

The finding of a mediating role of acceptance as measured by the CPAQ was observed between pain catastrophising and emotional adjustment and a partial mediating role between pain self-efficacy and emotional adjustment was also found. These findings emphasise that the degree to which thoughts and beliefs regarding pain influence emotional wellbeing, is dependent upon level of acceptance. Such findings are also reflective of theory underlying acceptance based approaches which emphasises the importance of context rather than content (Hayes, 2004). That is, the way in which an individual responds to physical sensations of pain, as well as negative thoughts and beliefs about pain and disability, is of more relevance than the specific nature of these internal experiences.

Such findings are also consistent with a recent review of catastrophising, which emphasises the importance of social context as well as interpersonal factors on the relationship between pain catastrophising and adjustment to pain (Sullivan, 2012). The results also support preliminary findings of the mediating role of acceptance in the relationship between cognitive components and adjustment, which similarly showed acceptance to be a mediator between pain catastrophising and negative thoughts and emotional adjustment (Elander *et al.,* 2009; Vowles *et al.,* 2008). The finding also that acceptance is a partial mediator of self-efficacy provides new support to the role that acceptance has in influencing other cognitive psychological processes in their ability to predict pain adjustment.

A lack of support for the TSK and the PIPS in predicting pain adjustment was inconsistent with existing research (Crombez *et al.,* 1999; Roelofs *et al.,* 2007; Wicksell, Lekander *et al.,* 2010; Wicksell, Olsson *et al.,* 2010). These findings could be due to the absence of other psychological variables, which are better predictors, being tested in these studies. The latter finding suggests that the components as measured by the PIPS and the CPAQ are distinctly different when predicting emotional adjustment. Further indication of this is evident from the confirmatory factor analysis results showing that the acceptance and cognitive variables were unable to be grouped together into two distinct latent variables of cognitions and acceptance. Consequently this finding could potentially question the construct validity of each of these measures as theoretically it could be assumed that components which are related to appraisals of pain should have a strong association with one another (Turk, 1994), as should processes concerned with how one responds to pain (McCracken *et al.,* 2005). Alternatively given the strong correlations observed between all cognitive and acceptance variables, it could be implied that actually all of these variables are inter-related and therefore unable to be defined into two unique categories.

A number of limitations of the current research, however, should be considered before results are applied to the wider population. Firstly, the cross-sectional design of this research does not support a cause-effect relationship, making it difficult to determine the precise direction of associations between variables as could be derived from studies of a longitudinal or experimental design. The use of self-report measures also presents a difficulty in this study, but also generally for research examining pain, which to a large extent is a subjective concept. Data generated is therefore based on individual perspective, and thus may not provide a true representation, particularly of physical disability which may be susceptible to bias. Additional limitations of the current research relate to the absence of data being collected regarding past of on-going psychotherapy. Given that both ACT and CBT are available within the service, it would have been useful to establish whether this had any impact upon the outcomes from the measures.

Further considerations regarding the method of analysis are related to the confirmatory nature of SEM. Although it has been highlighted that a good fitting model suggests an adequate interpretation of the data, care should be taken not to disregard other potential models and parameters that may actually further improve the fit (Hooper *et al.,* 2008). Therefore, although the results indicated that these models were acceptable within the specific sample at a single time point, caution should be exercised when generalising these results to the wider population and alternative models comparing similar constructs could be examined. Further investigation into the utility of latent cognitive and acceptance factors is necessary and research that employs a larger sample size with sufficient power to test both emotional and physical adjustment simultaneously when measureable variables are included in the model would also be valuable.

In terms of the clinical implications, as supported by previous studies, these current findings indicate a benefit more specifically of cognitive-based interventions in improving physical adjustment to pain. In particular increasing an individual's confidence in their ability to manage pain and to adhere to treatment regimens would reduce their pain associated disability, which is in line with traditional Cognitive Behavioural theory (Bandura, 1993; Turk, 1994).

Alternatively, when considering emotional adjustment to pain, the findings indicate a more prominent role for acceptance-based interventions. The finding that the influence of pain severity on emotional adjustment was dependent upon pain catastrophising, self-efficacy and acceptance, and similarly the influence that pain catastrophising and self-efficacy (to an extent) had on emotional adjustment were also dependent on acceptance, highlights the importance of treatment which elicits this psychological process. This is consistent with theory (McCracken *et al.,* 2004; Hayes, 2004) that increased acceptance, in terms of willingness to experience pain and activity engagement, reduces the level of distress experienced by negative thoughts and beliefs and by the pain experience itself, thus improving emotional adjustment.

This study offers an important contribution to the literature, by being the first to compare this fuller array of cognitive and acceptance variables simultaneously in their relationship between pain and adjustment. The findings also provide support for both Cognitive and Acceptance-based interventions in improving management and adjustment to living with chronic pain. Subsequently, given the preliminary nature of the majority of these findings, further research is required to support these results and to enable generalisation to the wider chronic pain population.

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8

Extended Results

8.1 Demographic Findings

The demographics of the study sample are presented in table 1. The results show that 57.9% of participants were female, and the mean age of the sample was 51.23 (SD 12.34) years. The majority of participants were within the medium range for socio-economic status and were also unemployed, with 36% of the sample being unable to work due to their pain. The mean duration for pain was 9.6 (SD 9.57) years. The most common type of pain was back pain (32.2%). However, a large proportion (14%) of the sample did experience pain in more than one body site or had a diagnosis of more than one disorder associated with their pain (8.4%). A high proportion of the sample (64%), were prescribed what was considered 'medium strength' pain medication (World Health Organisation, 1996).

8.2 Distribution of Data

Observations of the normal probability plots, residuals scatterplots and histograms revealed no major outliers, however did demonstrate slight negative skewness for the PDQ and PCS, and positive skewness for the PSEQ (Tabachnick & Fidell, 2006, p. 80), which indicates that more people scored highly on disability and pain catastrophising and had low scores on pain self-efficacy beliefs (see appendix 2). Statistical tests of normality revealed a significant Kolmogorov-Smirnov statistic of $p<0.05$ indicating significant negative skewness for the PDQ and the PCS, and significant positive skewness on the PSEQ (Pallant, 2002, p. 58), and a significant z-score of $p<0.001$ for skewness on the PDQ (Field, 2011, p. 138) (see appendix 3). Given the large sample size, some deviation from the norm should be expected and more value was therefore attributed to the observations of data distributions as recommended (Field, 2011, p. 138).

Table 1. Demographic Variables

Variable	Response Level	N	%	Mean (standard Deviation)
Age	Years			51.23(12.34)
Sex	Female	124	57.9	
	Male	90	42.1	
Socio-Economic Status	High	61	29.0	
	Medium	109	51.9	
	Low	40	19.1	
Employment	Employed FT	48	22.4	
	Employed PT	19	8.9	
	Retired	46	21.5	
	Student	3	1.4	
	Homemaker	5	2.3	
	Unemployed pain)	78	36.4	
	Unemployed (other)	15	7.0	
Education Years				12.88(3.32)
Education Level	No Qualifications	77	36	
	High School Qualifications	63	29.4	
	College Qualifications	48	22.4	
	University Degree	19	8.9	
	Postgraduate Degree	7	3.3	
Pain Duration	Years/ Months			9.6 (9.57)
Nature of Pain	Back Pain	69	32.2	
	Leg Pain	17	7.9	
	Fibromyalgia	15	7.0	
	Arthritis	20	9.3	
	Nerve Pain	29	13.6	
	Multi-site Pain	30	14.0	
	Multiple Disorders	18	8.4	
	Other	16	7.6	
Pain Medication	None	32	15.0	
	Standard	19	8.9	
	Medium	137	64.0	
	Strong	26	12.1	
Anti-Depressant	None	134	62.6	
	SSRI	24	11.2	
	Tricyclics	46	21.5	
	SSRI & Tricyclic	10	4.7	

FT = Full Time, PT = Part Time, SSRI =Selective Serotonin Reuptake Inhibitor

It has been recommended that when distribution is not normal that the robust statistical methods within the EQS program are employed to ensure that false conclusions regarding model adequacy are not being made. This application also computes robust standard errors, as well as robust versions of CFI,

NNFI and RMSEA (Bentler, 2004; Bentler & Yuan, 1999). When the assumptions of normality are violated, these methods have been shown to perform better than uncorrected statistics (Chou, Bentler & Satorra, 1991).

8.3 Data Screening

The mean scores and standard deviations and the internal consistency (Cronbach's Alpha) for each measure are presented in table 2. All measures demonstrated an Alpha value of above 0.7, which indicates sufficient reliability, with the exception of the Cognitive Fusion subscale of the PIPS, which had an Alpha value of 0.678, however is still acceptable (Cortina, 1993). Pearson correlations conducted to identify relationships between all variables showed that all of the measures and their subscales were significantly correlated with one another at the 0.01 level.

Given the large sample size however, and the number of correlations being conducted, the risk of committing a Type 1 error is increased because even small coefficients will be statistically significant. Post hoc analyses employing a Bonferroni adjustment to the alpha level, which determines the statistical significance, were therefore conducted. This allows a more conservative approach to be undertaken, reducing the likelihood of a Type 1 error (Pallant, 2002, p.174). This calculation increased the level of significance which is acceptable to $p<0.0001$. Correlations between variables and their level of significance are presented in Table 2.

The majority of correlations were medium to large, demonstrating strong relationships between these variables. Small to medium correlations, however, for the MPQ total and subscales demonstrates weaker relationships with all of the other variables, particularly the TSK, where all correlations were small. Very large correlations (>0.8) can be observed for the relationship between the CPAQ and PIPS, for the PSEQ and PDQ, and for the PSEQ and CPAQ. Although large, these correlations did not exceed 0.9, and Tolerance and VIF figures verified that the multicollinearity assumption had not been violated (Field, 2011, p224; Myers, 1990; Tabachnick & Fidell, 2007, p. 90).

Table 2 Means (M), Standard deviations (SD), internal consistency (α) and intercorrelations of all measures

	Measure	M (SD)	α	2	3	4	5	6	7	8	9
1	MPQ Total	25.12 (10.03)	0.854	0.421**	0.358**	0.486**	0.283**	-0.380**	-0.366**	0.380**	0.341**
	Sensory	18.90 (7.23)	0.789								
	Affective	6.21 (3.69)	0.775								
2	PDQ Total	89.86 (31.93)	0.937		0.763**	0.602**	0.537**	-0.817**	-0.723**	0.474**	0.631**
	Function	53.13 (20.3)	0.930								
	Psychosoc	36.73 (13.72)	0.843								
3	Depression	9.78 (5.19)	0.879			0.746**	0.494**	-0.749**	-0.756**	0.527**	0.622**
4	Anxiety	10.8 (5.21)	0.875				0.429**	-0.612**	-0.668**	0.592**	0.597**
5	TSK Total	42.35 (9.34)	0.865					-0.501**	-0.618**	0.466**	0.582**
6	PSEQ Total	26.64 (15.80)	0.951						0.811**	-0.532**	-0.701**
7	CPAQ Total	52.92 (21.19)	0.884							-0.672**	-0.819**
	AE	32.53 (15.26)	0.903								
	PW	20.39 (9.99)	0.785								
8	PCS Total	30.46 (14.13)	0.947								0.717**
	Rumination	10.37 (4.91)	0.916								
	Magnification	5.81 (3.55)	0.768								
	Helplessness	14.28 (6.86)	0.908								
9	PIPS Total	78.45 (20.45)	0.920								
	Avoidance	45.62 (15.85	0.935								
	Cog Fusion	32.83 (6.35)	0.678								

**p<0.0001 (two-tailed), AE = Activity Engagement, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, PW = Pain Willingness, TSK = Tampa Scale for Kinesiophobia.

When considering demographic variables, significant correlations at the 1% level were observed for the relationships between pain duration and MPQ and for years of education and the TSK, CPAQ and PIPS. However Pearson correlation coefficients indicated minimal relationships between these variables (r<0.30) (Pallant, 2002, p. 120), with only a small correlation between education and TSK scores being observed (r=0.327) (See appendix 4). This suggests that there was a small relationship between lower levels of education and greater fear of movement beliefs. The results of t-tests and Mann-Whitney U Tests, for the variables whereby data was not normally distributed, indicated that there were significant differences (p<0.01) between males and females on the PDQ, the HADS, the TSK, the PSEQ, and the CPAQ (see appendix 5). These showed that males had significantly higher levels of physical disability, depression and anxiety, and beliefs regarding fear of movement, whereas females had significantly higher levels of pain self-efficacy beliefs and were more accepting of their pain.

8.4 Hypothesis Driven Analysis

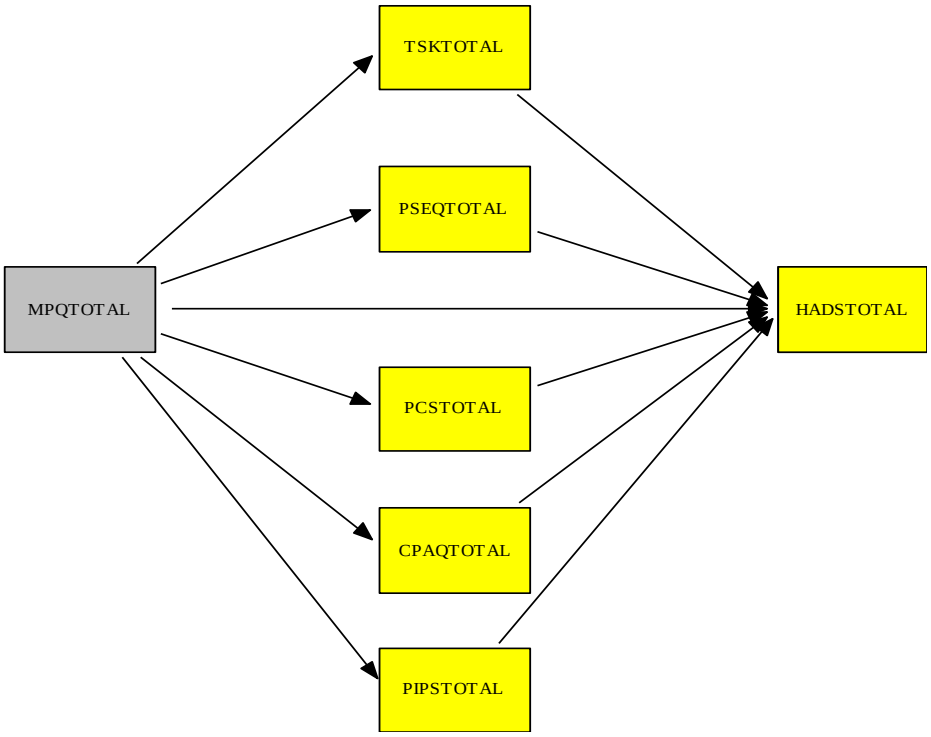
8.4.1 Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis was used to test whether the data loaded onto three separate latent variables, pain, cognitions and acceptance. The results showed that the initial three factor latent model, which was tested using EQS, indicated a poor fit as none of the fit indexes demonstrated an adequate value (Chi-square = 10463.671, df = 4001, CFI = 0.514, NNFI = 0.502, RMSEA = 0.087) (Hu & Bentler, 1999). Individual items that had weak loadings (standardised coefficients of <0.3), and therefore were not representative of the latent construct, were removed from the data in an attempt to improve the overall model fit. Those omitted from the analysis comprised items 5, 8, 12, 13, 16 of the TSK, items 4, 7, 11 and 16 from the CPAQ and items 4 and 5 from the PIPS. The results show, however, that this process had not greatly improved the overall fit of the model, which was still unacceptable (Chi-square = 8561.978, df = 3077, CFI = 0.551, NNFI = 0.539, RMSEA = 0.091). This indicates that the data does not suitably assimilate into either pain, cognitive or acceptance factors and this model was inappropriate to use in assessing the study hypotheses.

8.4.2 Hypothesis 1: Cognitive and acceptance components are mediators in the relationship between pain and emotional adjustment.

As the hypothesised CFA model did not fit the data and therefore latent variables could not be tested, path analysis was used as an alternative in order to test the hypotheses using measureable variables rather than the unobservable latent variables. The first hypothesised model (see figure 1) tests the mediating role of the acceptance and cognitive variables in the relationship between pain severity and emotional adjustment. As in all of the analyses conducted for each model, robust methods was used to account for non-normally distributed data and in the instance of a poor fitting model, non-significant pathways were removed and the model was re-run.

Figure 1: Hypothesised Simple Mediation Model 1: Emotional Adjustment Path Analysis



HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

Initial execution of the model revealed two pathways that did not reach statistical significance and therefore removed from the model. These were the relationships between the TSK and the HADS, and the PIPS and the HADS, which demonstrated that neither the TSK nor the PIPS predicted emotional adjustment, or had a mediating role between pain severity and emotional adjustment. The overall fit of the simple mediation model for emotional adjustment, however was poor, even after these non-significant pathways were omitted (Chi-square = 645.929, df = 12, NNFI = 0.041, CFI = 0.452, RMSEA = 0.461).

Despite being statistically significant, a further weak pathway ($\beta < 0.3$) was identified between the PCS and the HADS, highlighting that the PCS was a poor predictor of emotional adjustment. This pathway was subsequently removed from the model together with the variables that had weak loadings on emotional adjustment (these included the TSK, PCS and PIPS) and therefore did not contribute to the

overall variance accounted for by the model. The overall fit was marginally improved, however still unacceptable (Chi-square = 482.415, df = 6, NNFI = -0.53, CFI = 0.684, RMSEA = 0.614). Despite the poor model fit overall, it is clear that some important relationship exist within this model. The model demonstrates that the CPAQ and PSEQ were the strongest mediators of the relationship between pain and emotional adjustment, with the CPAQ having a greater role in predicting emotional adjustment (β = -0.555) than the PSEQ (β = -0.376).

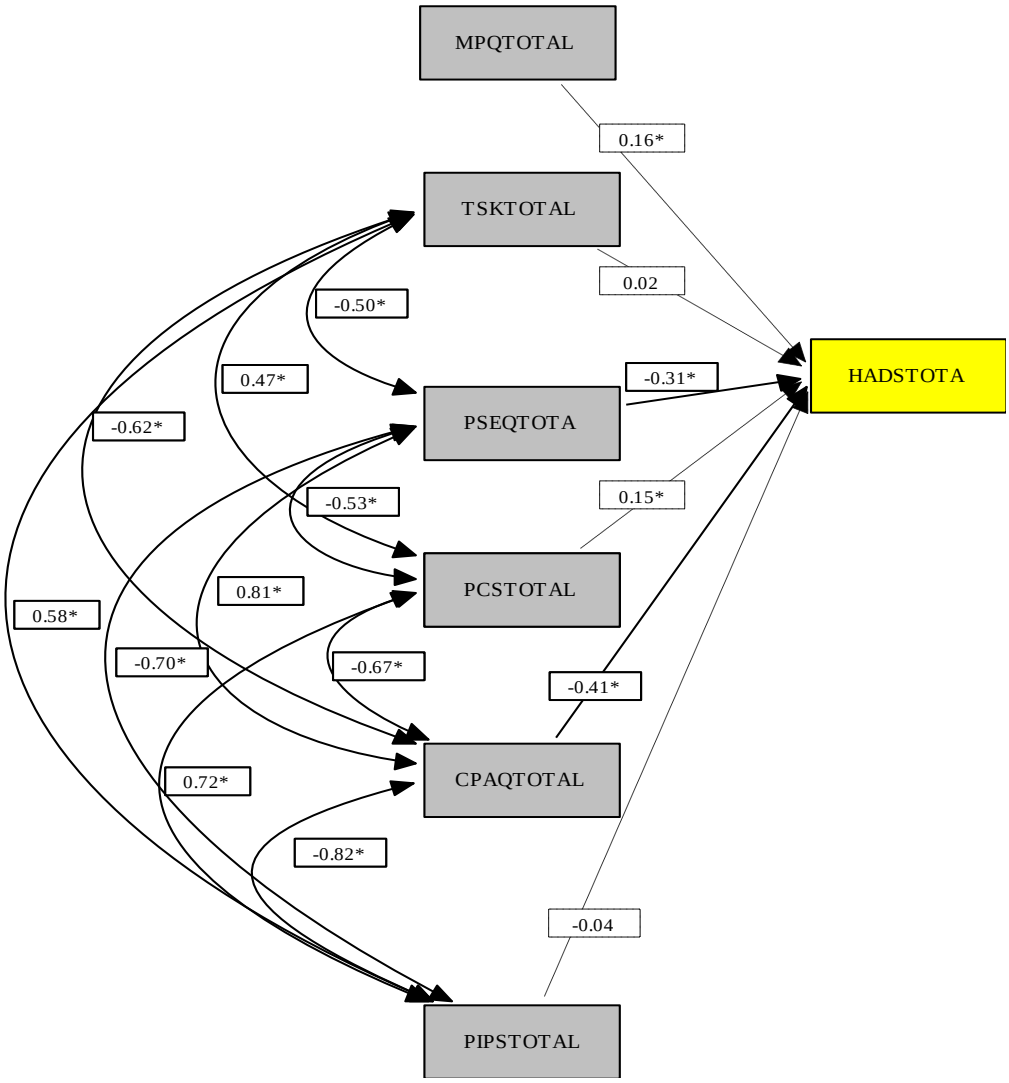
Table 3: Path Coefficients, Error and Variance Explained for Final Simple Mediation Model 1: Emotional Adjustment Path Analysis

Path	Standardised coefficient	Significance (p)	Error	Variance (R-Squared)
MPQ – PSEQ	-0.380	<0.05	0.925	0.144
MPQ – CPAQ	-0.366	<0.05	0.931	0.134
PSEQ – HADS	-0.376	<0.05	0.701	0.508
CPAQ – HADS	-0.555	<0.05		

HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

Table 3 shows the standardised path coefficients (β), the associated error and the proportion of variance (R-Squared) accounted for each of the dependent variables by the predictor independent variables within the model. The results indicate that a substantial amount of variance (R-squared = 0.508) was explained by pain, acceptance, and self-efficacy for emotional adjustment. Given the poor fit of the model however, this indicates that although acceptance and self-efficacy have a prominent role in explaining emotional adjustment, the hypothesised pathways within the model were not proficient in clarifying the exact nature of the relationship between these variables and emotional adjustment to pain.

Figure 2: Emotional Adjustment Model: Testing For Covariance



_____ confirmed pathways β>0.3, ---------- weak pathways β<0.3, *p<0.05

HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

Consequently, in order to gain more insight into the specific relationships, a further model was conducted to test for covariance between the cognitive and acceptance variables. The aim of this was to establish whether more complex relationships were present between these variables in predicting emotional adjustment to pain, which could explain a lack of adequate fit for the simple mediation model.

When the model was re-run testing for covariance between the cognitive and acceptance variables and their ability to predict emotional adjustment, a good fitting model was achieved as demonstrated by a CFI value of >0.95 (Chi-Square = 45.494, df = 5, NNFI = 0.828, CFI = 0.959, RMSEA = 0.195).

This model is presented in Figure 2. Double headed arrows between the cognitive and acceptance variables highlight covariance between the variables, represented by the correlation coefficients (r) between each of these relationships. Unidirectional arrows between the independent variables and dependent demonstrate the ability of these variables in predicting emotional adjustment. Values are standardised coefficients (β), which indicate the strength of each relationship. The model indicates the importance of the relationships between the cognitive and acceptance variables in predicting emotional adjustment and suggests a more complex system of pathways between these variables, which explains the poor fitting simple linear mediation model.

Table 4: Path Coefficients, Error and Variance Explained for Covariance Emotional Adjustment Model

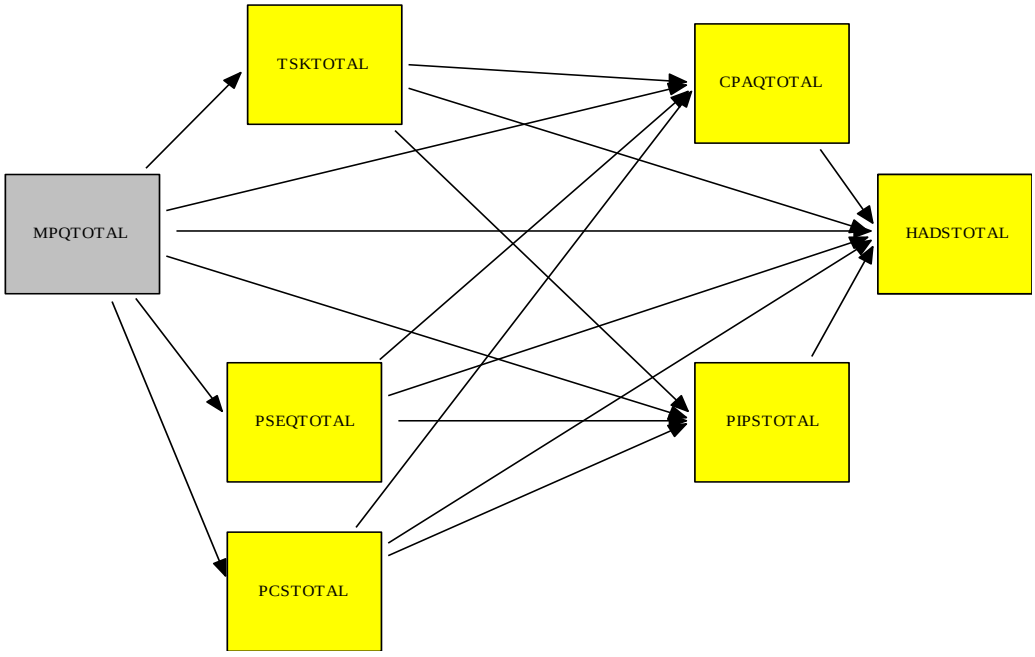
Path	Standardised coefficient (β)	Significance (p)	Error	Variance (R-Squared)
MPQ – HADS	0.160	<0.05	0.620	0.616
TSK – HADS	0.018	>0.05		
PSEQ – HADS	0.310	<0.05		
PCS – HADS	0.147	<0.05		
CPAQ – HADS	0.415	<0.05		
PIPS – HADS	0.044	>0.05		

HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

Table 4 presents the standardised path coefficients (β), the level of statistical significance (p), the associated error and the proportion of variance (R-Squared) accounted for the dependent variable by the independent predictor variables within the model. The results show that the PSEQ and the CPAQ

were the only substantial predictors of emotional adjustment, with the model on the whole accounting for a large amount, 62%, of the variance in explaining emotional adjustment (R-squared = 0.616). Although the pathways between the MPQ and the HADS, and the PCS and the HADS have reached statistical significance, the low standardised coefficient values (β <0.3) indicate that only a minimal amount of the variance is explained by these variables. These results provide important information in the justification of the hypothesised double mediation model of emotional adjustment, by indicating that more complex pathways are needed to explain emotional adjustment to pain.

Figure 3: Hypothesised Double Mediation Model 1: Emotional Adjustment Path Analysis



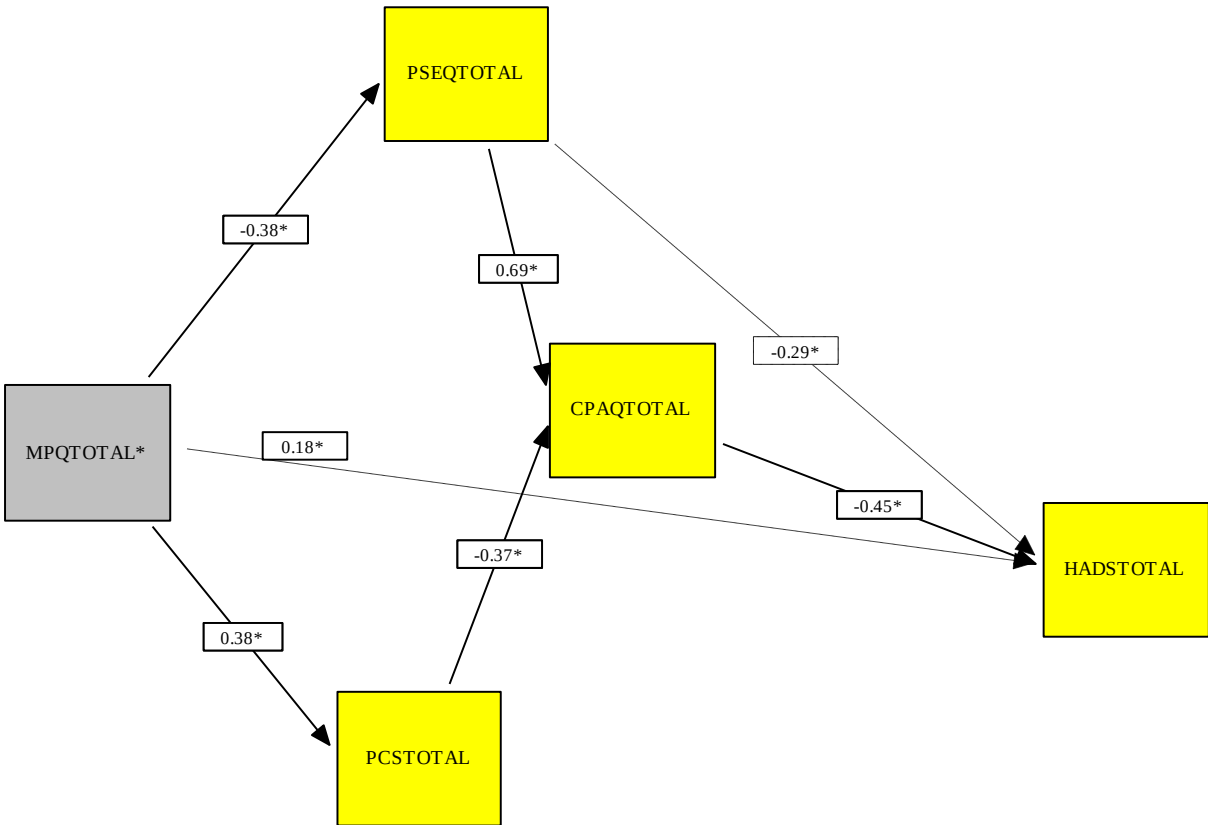
HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

8.4.3 Hypothesis 2: Acceptance components are mediators in the relationship between cognitive variables and emotional adjustmen to pain.

The hypothesised double mediation model (see Figure 3) postulates that as well as cognitive and acceptance variables having a mediating role in the relationship between pain and emotional adjustment, acceptance variables have a mediating role in the relationship between cognitive components and emotional adjustment. Non-significant pathways, which indicated a lack of association between variables, were identified between the MPQ and the CPAQ, the MPQ and the PIPS, the TSK and the HADS, and the PIPS and the HADS. The results show that once these non-significant pathways were eliminated, although a good fit is not demonstrated, the model may have more potential to explain the relationships between the different variables than the simple linear mediation model (Chi-Square = 146.228, df = 8, NNFI = 0.699, CFI = 0.885, RMSEA = 0.258).

Although significant, weak relationships were identified between the MPQ and TSK, the MPQ and the HADS, the TSK and CPAQ, the TSK and PIPS, and the PCS and the HADS, highlighting a weak contribution of these relationships to the overall variance explained by the model. On ommitting these pathways from the final model and also eliminating the TSK and PIPS due to their poor ability predict any of the dependent variables the final model revealed an adequate fit as demonstrated by a CFI value of >0.9 (Chi-Square = 68.619, df = 4, NNFI = 0.769, CFI = 0.908, RMSEA = 0.265). When considering the Lagrange Multiplier Test to establish whether the addition of any pathways would increase the model fit, this resulted in the addition of the pathway from the MPQ to the HADS into the model, which improved the model fit marginally (Chi-Square = 52.441, df = 3, NNFI = 0.745, CFI = 0.924, RMSEA = 0.278).

Figure 4: Double Mediation Model 1: Final Emotional Adjustment Path Analysis



_____ confirmed pathways β>0.3, ---------- weak pathways β<0.3, *p<0.05

HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

The final model is presented in figure 4 with the corresponding standardised path coefficients. The model indicates that within the relationship between pain and emotional adjustment, acceptance is a mediator between catastrophising and emotional adjustment and a partial mediator in the relationship between self-efficacy and emotional adjustment. The standardised path coefficients indicates that the acceptance has a stronger relationship with emotional adjustment (β = -0.45) than self-efficacy (β = -0.29), providing a more prominent role in the overall variance accounted for by the model

Table 5: Path Coefficients, Error and Variance Explained for Double Mediation Model 1: Final Emotional Adjustment Path Analysis

Path	Standardised Coefficient (β)	Significance (p)	Error	Variance (R-Squared)
MPQ – PSEQ	-0.380	<0.05	0.925	0.144
MPQ – PCS	0.380	<0.05	0.925	0.144
PSEQ – CPAQ	0.693	<0.05	0.559	0.687
PCS – CPAQ	0.367	<0.05		
CPAQ – HADS	-0.446	<0.05	0.621	0.614
PSEQ – HADS	0.291	<0.05		
MPQ – HADS	0.179			

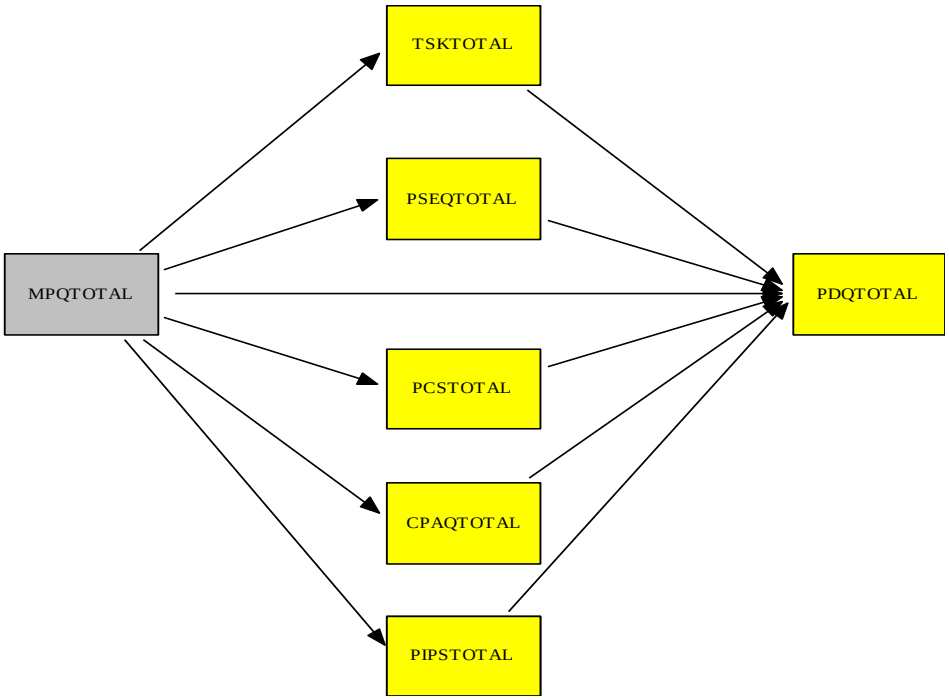
HADS = Hospital Anxiety and Depression Scale, CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

Table 5 shows the standardised path coefficients (β), the statistical significance, the associated error and the proportion of variance (R-Squared) accounted for each of the dependent variables by the predictor independent variables within the model. The results indicate that a substantial amount, 61%, of variance (R-squared = 0.614) was accounted for by pain, catastrophising, self-efficacy and acceptance in predicting emotional adjustment.

8.4.4 Hypothesis 1: Cognitive and acceptance components are mediators in the relationship between pain and physical adjustment.

The second hypothesised simple mediation model is presented in figure 5 and tests the mediating role of the cognitive and acceptance variables in the relationship between pain and physical disability. A number of pathways failed to reach statistical significance, indicating a lack of contribution to the overall model and as a result were removed. These included the relationships between the MPQ and the CPAQ, the MPQ and the PIPS, the PCS and the PDQ, the CPAQ and the PDQ, and the PIPS and the PDQ. The results show that after removing these non-significant pathways the overall fit of the model

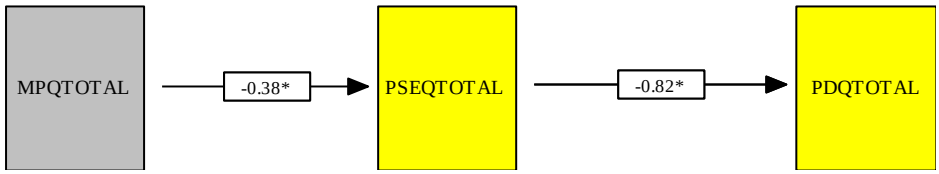
Figure 5: Hypothesised Simple Mediation Model 2: Physical Adjustment Path Analysis



CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

remained poor (Chi-square = 646.561, df = 12, NNFI =0.095, CFI = 0.483, RMSEA = 0.452). Subsequent removal of weak pathways (β<0.3), which provided a minimal contribution to the overall variance explained by the model was conducted. This involved eliminating relationships between the MPQ and the TSK, the TSK and the CPAQ, the TSK and the PIPS, the TSK and the PDQ, and the MPQ and the PDQ, as well as variables that had weak loadings on physical adjustment (including the TSK, PCS, CPAQ and PIPS), which resulted in the overall fit being considerably improved, demonstrating a good fit for the model (Chi-square = 9.324, df = 1, NNFI = 0.909, CFI = 0.970, RMSEA = 0.198).

Figure 6: Simple Mediation Model 2: Final Physical Adjustment Path Analysis



_____ confirmed pathways, *p<0.05

MPQ = McGill Pain Questionnaire, PDQ = Pain Disability Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

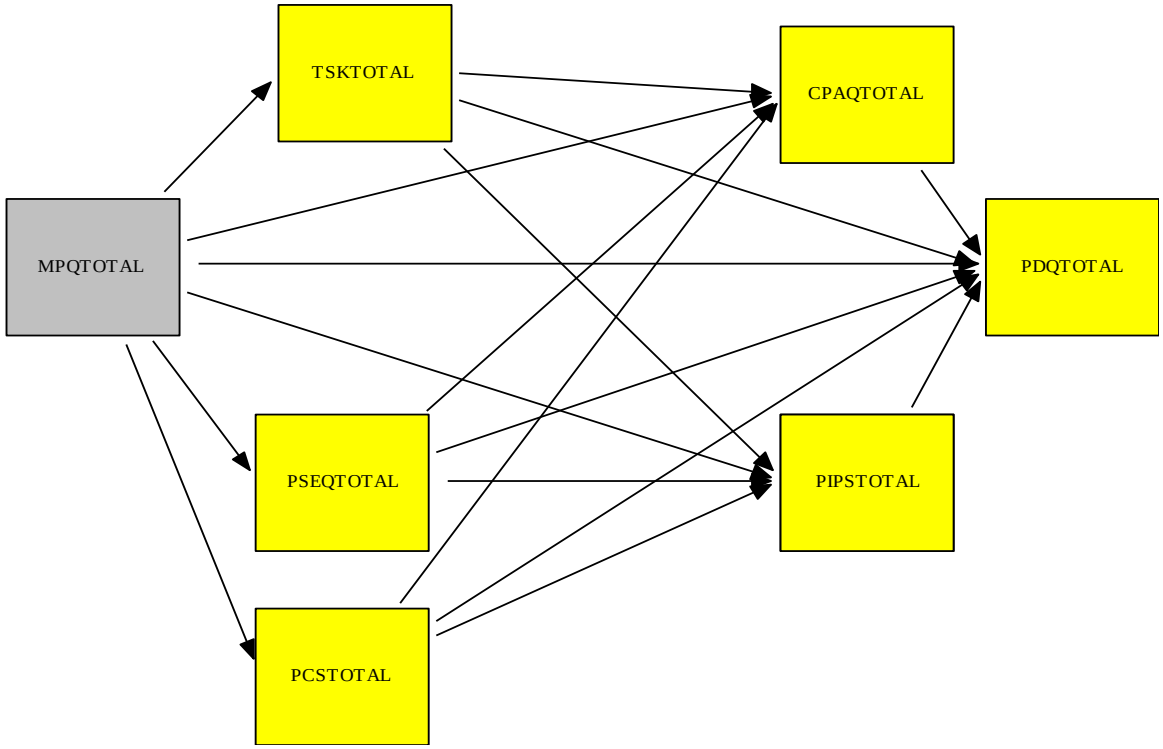
Table 6: Path Coefficients, Error and Variance Explained for Simple Mediation Model 2: Final Physical Adjustment Path Analysis

Path	Standardised Coefficient (β)	Significance (p)	Error	Variance (R-Squared)
MPQ – PSEQ	-0.380	<0.05	0.925	0.144
PSEQ – PDQ	-0.817	<0.05	0.576	0.668

MPQ = McGill Pain Questionnaire, PDQ = Pain Disability Questionnaire, PSEQ = Pain Self-Efficacy Questionnaire.

This final model is presented in figure 6 with the associated standardised path coefficients. This demonstrates that self-efficacy has a strong mediating role in the relationship between pain and physical adjustment. The removal of other cognitive and acceptance variables due to their weak loadings highlights the superiority of pain self-efficacy (PSEQ) as a mediator in the model. Table 6 shows the standardised path coefficients (β), the associated error and the proportion of variance (R-Squared) accounted for each of the dependent variables by the predictor independent variables within the model. The results indicate that a substantial, 67%, amount of the variance (R-squared = 0.668) was accounted for by pain and self-efficacy in predicting physical adjustment.

Figure 7: Hypothesised Double Mediation 2: Physical Adjustment Path Analysis



CPAQ = Chronic Pain Acceptance Questionnaire, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Questionnaire, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

8.4.5 Hypothesis 2: Acceptance components mediate the relationship between cognitive components and physical adjustment

The same procedure in order to test the mediating role of acceptance variables between cognitive components and physical adjustment was conducted as had been performed to test this relationship with emotional adjustment. Figure 7 illustrates the hypothesised double mediation model for physical adjustment to pain. A number of non-significant pathways were identified, including the relationships between the MPQ and CPAQ, the MPQ and PIPS, the PCS and PDQ, the CPAQ and PDQ, the PIPS and PDQ. The results showed that the model, with all of the cognitive and acceptance variables

included almost acheives an adequate goodness of fit level after removal of the non-significant pathways (Chi-Square = 148.003, df = 9, NNFI = 0.744, CFI = 0.890, RMSEA = 0.240).

The same procedure of removing further weak pathways which provided little impact to the overall ability of the model in explaining physical adjustment was administered. This included the relationships between the MPQ and TSK, the TSK and CPAQ, the TSK and PIPS, and the TSK and PDQ, and the variables that were poor predictors of the dependent variables (comprising the TSK, PCS, CPAQ and PIPS) was conducted. The final model produced, which provides the best fit for the variables (Chi-square = 9.324, df = 1, NNFI = 0.909, CFI = 0.970, RMSEA = 0.198) represents the same linear model which is presented in Figure 4. This indicates that self-efficacy is the only process variable to make a substantial contribution to physical adjustment when the other variables are accounted for. This result demonstrates that acceptance variables do not have a mediating role in the relationship between cognitive variables and physical adjustment and that pain self-efficacy is the strongest mediator of the relationship between pain and physical adjustment.

9

Extended Discussion

9.1 Current findings

The hypothesis that cognitive and acceptance components mediate the relationship between pain and physical and emotional adjustment is supported for physical adjustment to pain as well as emotional adjustment. For physical adjustment to pain, however, it was demonstrated that when all cognitive and acceptance variables were considered simultaneously, it was only pain self-efficacy that had a significant and strong mediating influence in the relationship between pain severity and physical adjustment. This indicates that irrespective of the severity of pain one is experiencing, the more confident the person is and the more he or she feels able to manage their pain and to engage in physical activities and treatment regimens the less likely the pain experience will interfere in their ability to manage daily activities.

This finding is supported by other studies that have shown self-efficacy to have an important direct role in predicting physical adjustment to pain as well as a mediating role between pain and physical adjustment (Arnstein *et al.,* 1999; Arnstein *et al.,* 2000; Asghari & Nicholas, 2001; Miro *et al.,* 2011; Nicholas & Asghari, 2006; Sarda *et al.,* 2009). An absence of studies, however, comparing the ability of self-efficacy with the other cognitive and acceptance variables simultaneously highlights the importance of the current finding that self-efficacy is the only substantial mediator when all other variables are accounted for.

Alternatively, when considering emotional adjustment, although the model had a poor fit, it was clear that acceptance had a more prominent role. When testing for covariance between the cognitive and acceptance components the model demonstrated a good fit, indicating the presence of more complex relationships between these variables in explaining emotional adjustment. This also highlighted the

substantial contributions particularly of acceptance and to a lesser degree, self-efficacy in predicting emotional adjustment, indicating their superiority in this role in comparison to the other process variables.

When testing the double mediation model for emotional adjustment it was apparent that, in line with the first hypothesis, acceptance, pain self-efficacy and catastrophising had a role in mediating the relationship between pain severity and emotional adjustment. These findings are consistent with existing research which demonstrates that acceptance is a better predictor of emotional adjustment including depression and anxiety, whereas physical adjustment is best predicted by self-efficacy (Nicholas & Asghari, 2006; Perry *et al.,* 2009; Sarda *et al.,* 2009; Viane *et al.*, 2003).

Explanations for these findings could be that as emotional adjustment is associated with level of pain related distress, and thus in accordance with theory, increased levels of pain acceptance reduce the degree of distress associated with the pain stimulus, by being willing to experience pain (McCracken *et al.,* 2005). Alternatively, the importance of beliefs in one's ability to engage in a specific behaviour despite pain and the association with increased physical functioning has been derived from earlier theoretical concepts of self-efficacy (Bandura, 1993). Furthermore, the importance of self-efficacy in improving physical functioning has also been highlighted in theory underlying social cognition models which demonstrate the role of self-efficacy in predicting engagement in specific behaviours and treatment regimens directly and via an increased intention to execute the behaviour (Azjen, 1991; Rosenstock *et al.,* 1988).

The double mediation models also provided support for hypothesis two that acceptance components would mediate the relationship between cognitive variables and adjustment to pain, however this was for emotional adjustment and not physical adjustment. A mediating role of acceptance as measured by the CPAQ, but not the PIPS, was observed between pain catastrophising and emotional adjustment and a partial mediating role between pain self-efficacy and emotional adjustment was also found. When

considering physical adjustment to pain, however, no mediating role of acceptance was found between cognitive variables and physical adjustment.

These findings suggest that the impact or function of catastrophic thoughts related to pain on emotional adjustment, are dependent on an individual's level of acceptance. Therefore if one is more accepting of pain, catastrophic thinking patterns are less likely to lead to higher levels of distress and have an impact upon emotional wellbeing. Similarly beliefs regarding one's ability to manage pain do still directly influence emotional adjustment, however to an extent these beliefs are also influenced by acceptance. This suggests that the degree to which self-efficacy beliefs influence emotional adjustment is dependent in part on how accepting an individual is with regard to their pain. Such findings are also reflective of theory underlying acceptance based approaches which emphasises the importance of context rather than content (Jacobson *et al.,* 1996; Burns & Spangler, 2001). That is, the way in which an individual responds to physical sensations of pain, as well as negative thoughts and beliefs about pain and disability, is of more relevance than the specific nature of these internal experiences.

These results are also consistent with a recent review of catastrophising, which emphasises the importance of social context as well as interpersonal factors on the relationship between pain catastrophising and adjustment to pain (Sullivan, 2012). This review proposes that more traditional models of catastrophising, which include cognitive theory, are too simplistic and are inclined to pathologise catastrophising by viewing it as a precursor to emotional distress. In line with the current findings, however, the occurrence of catastrophic thoughts within healthy individual was highlighted, challenging the notion of catastrophising as a pathological concept and placing more emphasis on context.

These current findings also support preliminary results of the mediating role of acceptance in the relationship between cognitive components and adjustment, which similarly showed acceptance to be a

mediator between pain catastrophising and negative thoughts and emotional adjustment (Elander *et al.,* 2009; Vowles *et al.,* 2008). In contrast to these existing findings, however, the current research did not show a mediating role of acceptance between catastrophising and physical adjustment. The finding also that acceptance is a partial mediator of self-efficacy provides new support to the role that acceptance has in influencing other cognitive psychological processes in their ability to predict pain adjustment.

The contribution of pain catastrophising to the variance accounted for in emotional adjustment but not for physical adjustment is also consistent with existing findings (Esteve *et al.,* 2007; Gillanders *et al*., Submitted). However, a lack of support for beliefs regarding fear of movement as measured by the TSK in its ability to predict emotional or physical adjustment to pain is contrary to some existing research (Crombez *et al.,* 1999; Roelofs *et al.,* 2007). Nevertheless, the nature of the current analyses used, which allows the predictive ability of fear of movement beliefs to be tested in comparison with several psychological components, suggest that when these other factors (acceptance, catastrophising and self-efficacy) are present, the TSK does not provide a substantial contribution to the variance explained by the models. This is concurrent with some existing research showing the superiority of psychological flexibility and acceptance in predicting adjustment to pain in comparison with fear of pain beliefs (Wicksell, Lekander *et al.,* 2010; Wicksell, Olsson *et al.,* 2010).

Furthermore an absence of findings which support the PIPS ability to predict adjustment to pain, are contrary to past research (Wicksell, Lekander *et al.,* 2010; Wicksell, Olsson *et al.,* 2010) and suggest that when other psychological components are present within the model, psychological flexibility as measured by the avoidance and cognitive fusion subscales, do not account for a notable amount of the variance in pain adjustment. Interestingly, this finding also indicates that within this sample, the components as measured by the PIPS and the CPAQ are distinctly different when predicting emotional adjustment. Although Avoidance and Cognitive fusion (PIPS) and Activity Engagement and pain willingness (CPAQ) are all acceptance-based components comprising psychological flexibility, these

results do suggest that each measure is tapping into a separate construct that are not closely related in their ability to predict emotional adjustment to pain.

This is also suggested by the results from the confirmatory factor analysis which showed that the acceptance and cognitive variables were unable to be grouped together into two distinct latent variables of cognitions and acceptance. This could similarly suggest that these are separate components which are measuring distinctive acceptance and cognitive constructs that differ in their relationships to physical and emotional adjustment to pain. Alternatively this finding could potentially question the construct validity of each of these measures. Theoretically it could be assumed that components which are related to appraisals of pain should have a strong association with one another (Turk, 1994), as should processes concerned with how one responds to pain (McCracken *et al.,* 2005). However, given the strong correlations observed between all cognitive and acceptance variables, it could be implied that actually all of these variables are inter-related and therefore unable to be defined into two unique categories as opposed to there being psychometric constraints associated with the measures.

The results from the present study provide an important contribution to this area of research, in particular due to the method of analyses employed in comparison with that used in existing studies. In comparison with other methods employing multiple regression analyses, Structural Equation Modeling has the capability of investigating complex multi-level relationships including a large number of variables concurrently, while also accounting for and removing measurement error (Ullman, 2007).

Research has shown that even when testing the simplest mediation models, SEM is superior to other methods due to the standard error being reduced as a result of simultaneous testing of the parameters within the SEM model (Iacobucci *et al.* 2007) rather than more traditional methods of conducting a series of multiple regression equations in a more disjointed manner (Baron & Kenny, 1986). The ability to assess complex multi-level path analyses while also providing a fit index of a hypothesised model is an additional advantage, which determines whether a particular model should be rejected despite the

observation of significant parameters (Bentler & Bonnett, 1980) and increases the superiority of SEM over more recent developments in mediation analysis (Preacher & Hayes, 2004).

9.2 Limitations of the Current Research

A number of limitations of the current research, however, should be considered before results are applied to the wider population. Firstly, the cross-sectional design of this research does not support a cause-effect relationship, making it difficult to determine the precise direction of associations between variables as could be derived from studies of a longitudinal or experimental design. That is, these findings do not conversely depict the potential influence that negative affect (depression and anxiety) has on the individual acceptance and cognitive components as well as on physical disability as has been shown in other research (Ericsson *et al.,* 2002).

The use of self-report measures also presents a difficulty in this study, but also generally for research examining pain, which to a large extent is a subjective concept. Data generated is therefore based on individual perspective, and thus may not provide a true representation, particularly of physical disability which may be susceptible to bias. Furthermore, as participants were recruited purely on their attendance at a pain clinic in order to gain an overview of the general chronic pain population, this was irrespective of their level of ability to cope with their pain and whether or not they had received any previous psychotherapy. As both CBT and ACT approaches are available within the service it would therefore have been useful to establish whether participants had received either, in order to observe any impact of this on the independent and/or dependent variables and the relationships between these.

Additional constraints with regard to the present study are associated with the use of Expectation Maximisation to impute missing data, in order to maximise the sample available for analysis and maintain sufficient power. As with all methods of managing missing data, this approach is vulnerable to bias given that error is not included with the imputed data set, meaning that inappropriate standard errors are present when data is analysed (Graham & Donaldson, 2003). However, given the small

proportion of data missing and the nature of this (missing completely at random), the risk of bias was minimised (Tabachnick & Fidell, 2007, Ch.4). Furthermore, the non-normally distributed data could also potentially lead to difficulties particularly in conducting multivariate analyses however the application of robust statistical methods within EQS is able to account for this (Bentler, 2004).

In terms of demographic variables which have been shown to influence pain severity as well as components of physical and emotional adjustment (Affleck *et al.,* 1999; Edwards *et al.,* 2000; Rios & Zautra, 2011), the current study showed that no strong correlations existed between demographic and the process and dependent variables. The results from the t-test, however, demonstrated an exception of gender, with significant differences being identified between males and females on a number of components including physical and emotional adjustment to pain. Unfortunately, due to constraints associated with the program used (EQS 6.2), categorical variables were unable to be included in the analysis when the model included measureable independent variables (Bentler, 2004). This meant that the potential moderating influence of gender on pain adjustment was unable to be tested.

Unfortunately as the results of the Confirmatory Factor Analysis demonstrated a poor fitting model when considering pain severity, acceptance components and cognitive components as three separate latent variables, further analysis could only include measureable variables. The inability to include latent variables meant that in order to maintain sufficient power (Schreiber *et al.,* 2006), the two dependent variables, emotional and physical adjustment could only be tested in separate models. Alternatively, testing both dependent variables simultaneously within the same model, would have provided important findings regarding the relationships between variables when both emotional and physical adjustment were present, while also having the benefit of observing the predictive parameters more coherently within one distinct model.

Further considerations regarding the method of analysis are related to the confirmatory nature of SEM. Although it has been highlighted that a good fitting model suggests an adequate interpretation of the

data, care should be taken not to disregard other potential models and parameters that may actually further improve the fit (Kenny, 2011). Therefore, although the results indicated that these models were acceptable within the specific sample at a single time point, caution should be exercised when generalising these results to the wider population and alternative models comparing similar constructs could be examined.

9.3 Clinical Implications and future directions

The results provide support for both Cognitive and Acceptance-based interventions for improving management and adjustment to living with chronic pain. As supported by previous studies, these current findings indicate a benefit more specifically of cognitive-based interventions in improving physical adjustment to pain. In particular increasing an individual's confidence in their ability to manage pain and to adhere to treatment regimens would reduce their pain associated disability. In line with Cognitive Behavioural theory (Bandura, 1993; Turk, 1994), as demonstrated by the results, the influence that pain severity has on physical adjustment to pain is largely dependent upon pain self-efficacy beliefs, highlighting the importance of increasing such beliefs regardless of the level of pain experienced.

The absence of a mediating role of acceptance variables between self-efficacy and physical adjustment, suggests a direct relationship between these beliefs and perceived disability rather than increased pain self-efficacy beliefs improving physical adjustment via increased activity engagement and/or pain willingness. The subjective nature of the PDQ, however, indicates that the outcome is related more to beliefs about the interference of pain than actual disability, which could also explain the close association with beliefs regarding ability to manage pain. Future research that investigates these relationships whilst employing an objective measure of physical disability would be important, and may produce different results.

Alternatively, when considering emotional adjustment to pain, the findings indicate a more prominent role for acceptance-based interventions. The finding that the influence of pain severity on emotional adjustment was dependent upon pain catastrophising, self-efficacy and acceptance, and similarly the influence that pain catastrophising and self-efficacy (to an extent) had on emotional adjustment were also dependent on acceptance, highlights the importance of treatment which elicits this psychological process. This is consistent with theory (McCracken *et al.,* 2004; Hayes, 2004) that increased acceptance, in terms of willingness to experience pain and activity engagement, reduces the level of distress experienced by negative thoughts and beliefs and by the pain experience itself, thus improving emotional adjustment. This provides further support for Acceptance and Commitment Therapy and Mindfulness-based approaches for improving emotional adjustment to chronic pain.

Important future directions within this area of research would include further investigations of the predictive ability of the PIPS specifically. The relatively novel nature of this measure as well as it's apparent lack of similarity to the CPAQ in influencing psychological processing in chronic pain, in the current study, warrants further research to assess its' utility in predicting pain adjustment, particularly when other cognitive and acceptance variables are being tested simultaneously. As both the PIPS and CPAQ are essentially targeting constructs with considerable overlap within the central component of psychological flexibility (Wicksell *et al.,* 2008), further assessment of the external validity of the PIPS should also be implemented.

In addition, research incorporating values-based action, a key component within the acceptance and commitment theory, in further comparisons of the role of acceptance and cognitive components in pain adjustment would be useful, given its' identified importance in the recent literature (McCracken & Vowles, 2008; McCracken & Yang, 2006). Furthermore, research which investigates the relationships between pain, acceptance and cognitive components in their ability to predict pain adjustment over time would also be highly relevant within this area. Additionally, more studies investigating the process variables involved in research which compares ACT or Mindfulness to CBT, would provide further

information regarding the importance of each of these constructs in adjusting to pain, while also providing additional support for the direction of these relationships which can only be speculated from cross-sectional designs.

Consequently studies that extend the current research by incorporating demographic variables, such as gender into the hypothesised model, would be valuable as well as research investigating potential moderating relationships their influence in improving the goodness of fit of the model. In addition further investigation into the utility of latent cognitive and acceptance factors is necessary and research that employs a larger sample size with sufficient power to test both emotional and physical adjustment simultaneously when measureable variables are included in the model would also be valuable. Subsequently, given the preliminary nature of the majority of these findings, further research is required to support these results and to enable generalisation to the wider chronic pain population.

On reflection, however, the very nature particularly of ACT approaches which have roots in functional contextualism, creates difficulties when trying to measure and define specific constructs comprising psychological flexibility (Biglan & Hayes, 1996; Hayes, 2004). Hypothetical labels given to the different concepts underlying ACT approaches are necessary to aid understanding of this approach and enable its use therapeutically however, the very process of doing so is contrary to the underlying philosophical assumptions. Contextual behavioural science places emphasis on the context of an individual's behaviour and interactions, and rejects ontological perspectives that these processes can be classified or categorised as specific entities (Hayes, 2004). Self-report measures developed in order to provide some insight into this theory are therefore problematic and are merely capturing an element or snapshot of what is essentially a fluid and ongoing set of interactions which are historically and situationally defined.

Consequently from this perspective the current research and any research for that matter which attempts to measure the 'constructs' within ACT are faced with these complexities. It should however

be clarified that the aims of this research are not necessarily trying to uncover what is true and what is real, but endeavouring to provide a workable analysis of psychological events that although cannot access the precise nature of these, can provide findings that are useful and meaningful within this context. These challenges should be considered by future researchers within this field.

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Conclusion

In conclusion the results show that acceptance and cognitive variables have a role in mediating the relationship between pain severity and pain adjustment. Furthermore findings also show that acceptance has a mediating role in the relationship between pain catastrophising and emotional adjustment and partially between self-efficacy and emotional adjustment. The study highlights the superior role of self-efficacy in predicting physical adjustment to pain, whereas acceptance has the most prominent role in predicting emotional adjustment. This has important implications for the application of Cognitive Behavioural Therapy and Acceptance and Commitment Therapy, indicating the importance of the former in reducing pain interference and disability, and the latter in reducing distress associated with the experience of pain as well as pain related thoughts and beliefs, in order to improve emotional wellbeing. This study offers an important contribution to literature, by being the first to compare this fuller array of cognitive and acceptance variables simultaneously in their relationship between pain and adjustment. Further research is required, however, to provide additional support for these findings in order to generalise to the wider chronic pain population.

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12.1 Appendix 1

Recruitment Methods Comparison

12.1.1 Table Showing Mean Scores and T-test Results for the Effects of Recruitment Method on All Measured Variables

12.1.2 Table Showing Chi Square Results for the Effect of Recruitment Method on Gender

Appendix 1.1: Table Showing Mean Scores and T-test Results for the Effects of Recruitment Method on All Measured Variables

Variable	Method of Recruitment	Mean and Standard Deviation	Significance Level
Age	In Clinic By Post	51.64 (14.26) 51.08 (11.61)	p>0.05
Pain Duration	In Clinic By Post	8.54 (9.64) 9.96 (9.54)	p>0.05
MPQ	In Clinic By Post	25.58 (9.12) 24.96 (10.35)	p>0.05
PDQ	In Clinic By Post	87.35 (30.80) 90.72 (32.36)	p>0.05
HADS	In Clinic By Post	18.08 (9.16) 20.48 (9.86)	p>0.05
TSK	In Clinic By Post	41.41 (9.30) 42.67 (9.14)	p>0.05
PSEQ	In Clinic By Post	28.35 (15.05) 26.04 (15.90)	P>0.05
CPAQ	In Clinic By Post	56.64 (21.17) 51.64 (21.11)	p>0.05
PCS	In Clinic By Post	27.68 (15.59) 31.42 (13.51)	p>0.05
PIPS	In Clinic By Post	75.29 (22.48) 79.54 (19.66)	p>0.05

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

Appendix 1.2: Table Showing Chi Square Results for the Effect of Recruitment Method on Gender

Gender	Recruitment Method	Proportion (%)	Significance (p)
Female	In Clinic By Post	67.3% 54.7%	>0.05
Male	In Clinic By Post	32.7% 45.3%	

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12.2 Appendix 2

Participant Study Pack

12.2.1 Participant Information Sheet

12.2.2 Participant Consent Form

12.2.3 Demographics Questionnaire

Appendix 12.2.1

Patient Information Sheet

The Role of Cognitive and Acceptance Components in Pain Adjustment (1)

Background to the study
Chronic pain results in life changes and losses in a person's life which can be very difficult to deal with. The experience of pain is very different for each individual and research has shown that a person's ability to cope can often depend upon their underlying psychological processes. For example, certain beliefs or thoughts you have regarding your pain may influence how well you manage it, and similarly, the way in which you perceive your pain can also have an impact on how successfully you can adjust.

Purpose of this Study
This study aims to gain a better understanding of how people cope with their pain by looking at the specific beliefs and perspectives that people adopt to manage their pain. Often these are unknown to the individual and therefore this study will provide greater insight into the underlying psychological processes which influence a person's ability to cope more successfully with their pain. In doing so, important information will be obtained as to how to best help people who are suffering from chronic pain, from a psychological perspective. The results from this research could therefore contribute towards informing the development of treatments and interventions to help improve quality of life for people living with pain.

Why have I been invited?
You have been invited to take part because you are a pain sufferer and have been receiving or are due to receive treatment and advice within a Multi-disciplinary Pain Clinic or via Pain Association Scotland. We aim to gain participation from approximately 200 other people who have similar circumstances to you.

Do I have to take part?
It is your decision as to whether you join the study. If you do agree to take part, we will then ask you to sign a consent form. You are free to withdraw at any time, without giving a reason and this will not affect the standard of care you receive. Before making the decision to take part in the study you are invited to contact the researcher below and/or discuss participation with a professional within the Pain Clinic or Pain Association.

What will happen to me if I take part?
If you decide to take part, firstly, you will be required to sign the enclosed consent form to indicate your agreement in participating. You will then be asked to complete the enclosed

questionnaires which should take no longer than 30 minutes in total. These questionnaires can either be completed by you at home or within the clinic and returned either by post within the stamped addressed envelope provided, or placed in the envelope and handed to a member of staff from the Pain Clinic you attend or Pain Association group. Alternatively, you can contact the researcher on the telephone number provided below to arrange a time to complete these questionnaires over the phone. There is also the option to complete the questionnaires online. If you wish to do this, please notify the researcher who will provide you with a web link. All answers you provide will be anonymous and once your consent form has been received, it will be kept separate from the questionnaires to ensure confidentiality. The results from all participants will be gathered together and presented in an academic journal for other professional to refer to. Please note, a letter will be sent to your GP to inform them of your participation in this study.

We are very grateful for your time taken in reading this information sheet and would greatly appreciate your help in participating in this research. If you have any queries prior to or after completing these questionnaires, please do not hesitate to contact the researcher (details below) who will be happy to answer any questions you may have.

Researcher: Louisa Fraser
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Consultant Clinical Psychologist
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If you are displeased with any aspect of this research and wish to make a complaint, please contact Ruth Salter on the following contact details:

Ruth Salter
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Appendix 12.2.2

Participant Number _____

Consent Form

The Role of Cognitive and Acceptance Components in Pain Adjustment (1)

	Please Tick
I have read the information sheet and understand what taking part in this study will involve.	☐
I am aware that my involvement in the study will be anonymous.	☐
I understand that my answers from the questionnaires will be collated with data from a large number of other participants.	☐
I have an understanding that the results will be presented in an academic journal for other professionals to read.	☐
I give my full consent to taking part in this study.	☐

Signature …….

Date ……..

Researcher: Louisa Fraser
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Clinical Supervisor: Gill MacLeod
Consultant Clinical Psychologist
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Appendix 12.2.3

Participant Number _____

The Role of Cognitive and Acceptance Components in Pain Adjustment (1): Questionnaire Booklet

Background Information

1. Age? _____ 2. Post Code? _____

3. Male or Female (Please circle)

4. Employment Status (Please circle from below)

Employed Full Time Employed Part Time Unemployed Retired Student

Not working due to pain Not working for other reason Homemaker

5. Job title (if unemployed or retired, please give detail of most recent job)?

_____

6. How many years were you in education? _____

7. Please indicate any academic achievements
(e.g. number of Standard Grades, Highers, College qualification, University Degree)

_____

8. Please indicate how long you have been experiencing chronic pain

_____ Year(s) _____ Month(s)

9. Please indicate the diagnosis or reason you have been given for your pain (if any).

_____

10. Please specify the name(s) and dose of any medication you are currently prescribed.

_____

11. Please indicate any other health issues/ diagnoses below (Please continue over page).

_____

12.3 Appendix 3

Tests of Normality

12.3.1 Histogram for the Pain Disability Questionnaire

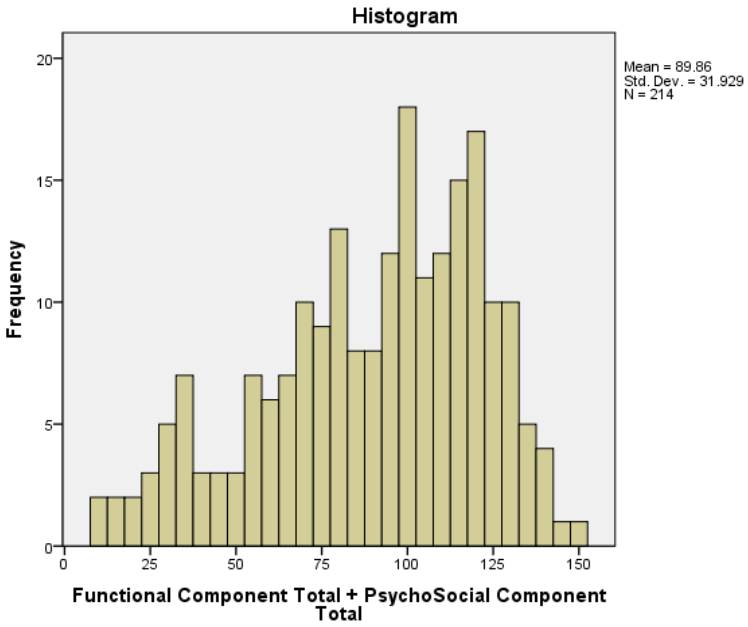
12.3.2 Histogram for the Pain Self-Efficacy Questionnaire

12.3.3 Histogram for the Pain Catastrophising Scale

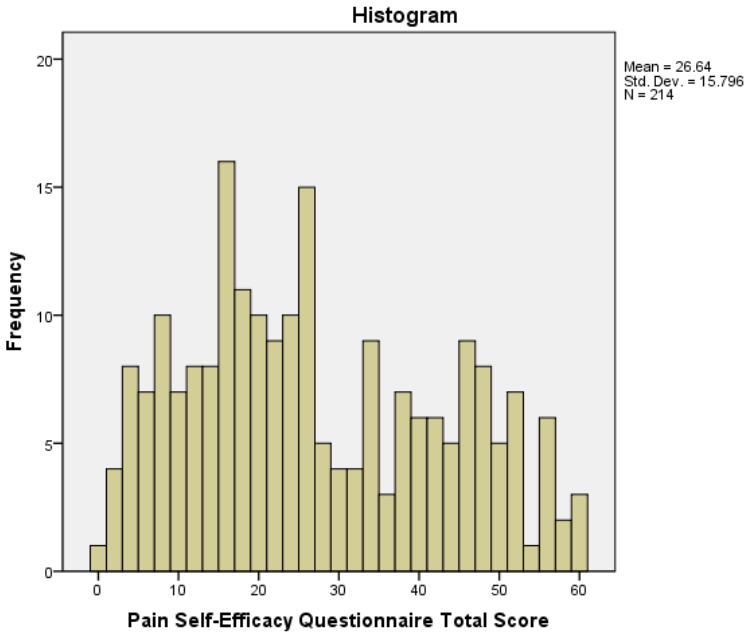
12.3.4 Table Showing Kolmogorov-Smirnov Test Statistics

12.3.5 Table Showing Z-Score Test Statistics

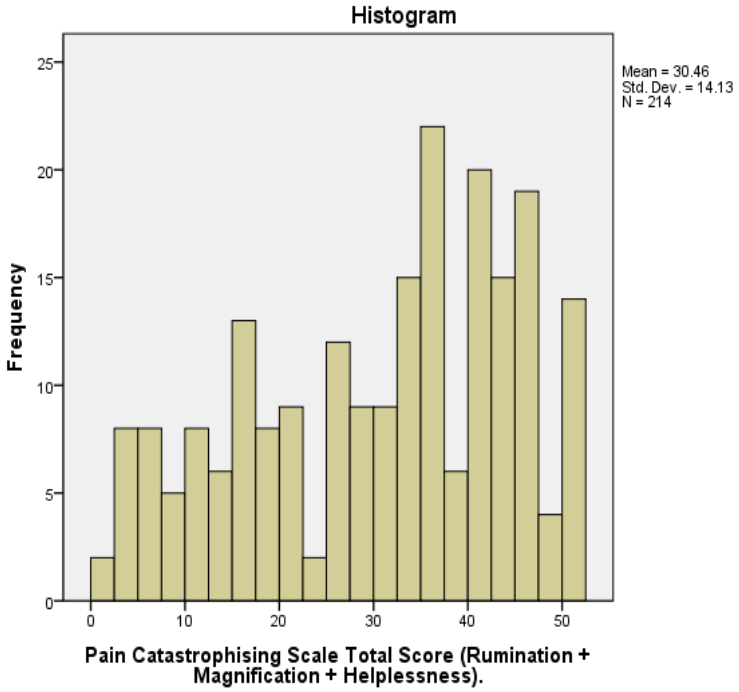
Appendix 3.1: Histogram Showing Negative Skewness for the Pain Disability Questionnaire (Comprising Functional and Psychosocial Subscales)



Appendix 3.2: Histogram Showing Positive Skewness for the Pain Self-Efficacy Scale



Appendix 3.3: Histrogram Showing Negative Skewness for the Pain Catastrophising Scale (Comprising Rumination, Magnification and Helplessness Subscales)



Appendix 3.4: Table Showing Kolmogorov-Smirnov Statistics for Each Measure to Assess Data Distribution

Measure	Kolmogorov-Smirnov Statistic	Significance (p)
PDQ	0.087	<0.001
HADS Depression	0.075	<0.01
HADS Anxiety	0.082	<0.01
TSK	0.047	>0.05
PSEQ	0.095	<0.001
CPAQ	0.045	>0.05
PCS	0.109	<0.001
PIPS	0.051	>0.05
MPQ	0.081	<0.01

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

Appendix 3.5: Table Showing Z-Score Statistics for Each Measure to Assess Data Distribution

Measure	Skewness	Standard Error	Z score Skewness	Sig Skewness	Kurtosis	Standard error	Z Score kurtosis	Sig Kurtosis
PDQ	-0.548	0.166	3.30	P<0.001	-0.453	0.331	1.368	>0.05
HADS	0.162	0.166	0.975	P>0.05	-0.819	0.331	2.47	<0.05
TSK	0.134	0.166	0.807	P>0.05	-0.091	0.331	0.275	>0.05
PSEQ	0.329	0.166	1.981	P<0.05	-0.981	0.331	2.964	<0.01
CPAQ	0.186	0.166	1.121	P>0.05	-0.566	0.331	1.710	>0.05
PCS	-0.404	0.166	2.434	P<0.05	-0.971	0.331	2.934	<0.01
PIPS	-0.251	0.166	1.512	P>0.05	-0.788	0.331	2.381	<0.05
MPQ	-0.071	0.166	0.428	P>0.05	-0.918	0.331	2.773	<0.01

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

12.4 Appendix 4

Correlations for Demographic Variables

12.4.1 Table Showing Pearson Correlations for Age, Education and Pain Duration

Appendix 4.1: Table Showing Pearson Correlations and Significance Level Between Demographic Variables (Age, Education and Pain Duration) and all Measures

Measure	Age	Education years	Pain duration
MPQ	-0.075	-0.033	0.268***
PDQ	-0.056	-0.187**	0.099
HADS Depression	-0.046	-0.105	0.075
HADS Anxiety	-0.120	-0.111	0.151*
TSK	0.053	-0.327***	0.028
PSEQ	0.057	0.185**	-0.035
CPAQ	0.079	0.238***	0.036
PCS	-0.103	-0.094	-0.012
PIPS	-0.028	-0.243***	-0.005

*significant at 0.05, ** significant at 0.01, *** significant at 0.001

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

12.5 Appendix 5

Tests for Effects of Gender

12.5.1 Table Showing T-Test Results for Gender on all Measures

12.5.2 Table Showing Mann-Whitney U Test Results for Gender

Appendix 5.1: Table Showing T-Test Scores and Significance to Assess for Differences in Gender on Independent and Dependent Variables

Measure	Mean and SD females	Mean and SD males	T	Significance
MPQ	24.05 (10.447)	26.59 (9.290)	-1.874	p>0.05
PDQ	83.71 (31.655)	98.32 (30.494)	-3.385	P<0.01
HADS	17.81 (9.199)	22.70 (9.758)	-3.742	P<0.001
TSK	40.27 (8.667)	45.21 (9.518)	-3.953	P<0.001
PSEQ	30.17 (15.566)	21.77 (14.865)	3.972	P<0.001
CPAQ	58.12 (20.667)	45.77 (19.876)	4.382	P<0.001
PCS	28.84 (14.159)	32.69 (13.859)	-1.981	P<0.05
PIPS	75.97 (20.286)	81.86 (20.303)	-2.095	p<0.05

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.

Appendix 5.2: Table Showing Mann-Whitney U Tests to Assess for Differences in Gender on Independent and Dependent Variables

Measurement	Significance (p value)
Pain duration	>0.01
MPQ Total	>0.01
Sensory	>0.01
Affective	>0.01
PDQ Total	<0.01
Function	<0.01
Psychosocial	<0.01
HADS Total	<0.01
Depression	<0.01
Anxiety	<0.01
TSK Total	<0.01
PSEQ Total	<0.01
CPAQ Total	<0.01
Activity Engagement	<0.01
Pain Willingness	>0.01
PCS Total	>0.01
Rumination	>0.01
Magnification	>0.01
Helplessness	>0.01
PIPS Total	>0.01
Avoidance	0.01
Cognitive Fusion	>0.01

CPAQ = Chronic Pain Acceptance Questionnaire, HADS = Hospital Anxiety Depression Scale, MPQ = McGill Pain Questionnaire, PCS = Pain Catastrophising Scale, PDQ = Pain Disability Questionnaire, PIPS = Psychological Inflexibility in Pain Scale, PSEQ = Pain Self-Efficacy Questionnaire, TSK = Tampa Scale for Kinesiophobia.